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THE CHANGING FACE OF BENGAL

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Thornton's Map of Bengal.

CHAPTER I

A PREFACE TO RIVERINE ECONOMICS

The Shifting Balance of Region and Man. In the following lectures I have undertaken an intensive study of the Ganges delta, with reference to the factors that govern the use of land and distribution of population. It is the meticulous study of a definite natural region, which alone can bring out principles of connection between man's numbers and his habitat and, therefore, help towards making regional economics a science. O. Schluter defines the field of human geography in these terms : " In human geography we shall discover that in the realm of human activities there is no lack of objects, which belong as properly to the landscape as do forests and meadows, rivers and mountains. Primarily we are concerned with visible corporeal objects. Man is considered in addition to his work, not as individual, but in his varying expressions of population density. Visibility and tangibility of the objects is, however, not sufficient. In addition they must have significance in the composition of the landscape. They must have, therefore, a certain areal extent or must be capable of being composed mentally in areal terms."

Man and his works thus form part of the area whose content and individuality it is the task of human geography to investigate. The most striking fact that emerges in such investigation is the balance, though a shifting one, between man, his presence, the very factor of the existence of population, and the rest of nature. Such balance is a complex

resultant of actions and interactions, which man only partially comprehends, but which sweep through him, up and down and all around, bringing the various parts of inanimate and animate nature into one interconnected whole. Man's doings reverberating through nature, however, often produce, instead of harmonies, disturbances, which redound to insecurity and sometimes ruin of his generations. Economic history reveals how in crowded regions the unconscious or wilful disregard of regional balance, the result of population pressure, may ultimately lead both man and his habitat to a common doom. The conditions of the maintenance or disturbance of regional balance, therefore, form a subject of great practical interest in economics. The growth and decay of civilisation often, indeed, exhibit not merely nature's gifts, but also her reprimands which man himself invites by his own deeds.

The Ganges valley is a most interesting region from the standpoints of both regional economics and demography. It is the most heavily populated in the world comprising about 125 million persons, which exceed the aggregate population of Great Britain, France, Belgium and Holland by 25 millions. The plains of China, which also are exceedingly congested, are far more varied from the point of view of soil conditions and habitability, and the density there is accordingly very unequally distributed. On account of the heavy density, as well as a uniform distribution of population over centuries in the past in the Ganges valley, there is no other region where we can study the interaction of man and his environment so advantageously. The uniform diffusion of population is chiefly the result of the more or less uniform course of the Ganges along its ancient channel through the centuries, carving out the landscape into level valleys suitable for the aggregation of man.

The Life-History of a River. The main river and its tributaries, according to their youth, maturity, and

advanced age, exhibit wide valleys and broad flood plains subject to inundation, or broken profiles and narrow valleys intersected by ravines, leading to marked differences in cropping and farming practice. The Ganges herself, though a very old river, only in her lower course shows signs of advanced age; while in her middle course she is mature and in her upper course still youthful. In her upper and middle courses the work of soil erosion and transport is still going on. In the middle course the destruction of vegetation along the banks, due to extension of cultivation and indiscriminate grazing, has sometimes made more active the process of soil erosion. This affects both irrigation and cultivation in the riverine tract. In the lower course the level, of the river-bedland the banks, is now above that of the surrounding country as the result of the process of sedimentation. The flood waters thus overflow the banks in the active delta and cover the country with alluvial deposits. During the flood season the drainage is towards the inland depressions and marshes along successive terraces of rice-fields, which in this manner are irrigated. Indeed, with the exception of the narrow strip of higher land on each side of the river, which is usually densely covered with villages, the country seems to be almost wholly submerged. But such flooding is indispensable, not only for the type of cultivation, but also for scouring and drainage. When, however, the flood season is over and the water falls, the movement is reversed; the immense volume of water, contained by the lateral spill basins during the flood season, gradually flows through every *khal* or channel into the river, after having deposited its silt and fertilised the land. All this has important effects on both agricultural productivity and density of population.

Causes of River Changes and Developments. Everything depends, however, on the free river spill and

discharge through the utilisation of an intricate and extensive network of watercourses. An old or dead river, whose flow is checked by shoal and vegetation, and which has lost its communication with its channels and their ramifications, instead of distributing the fertilising red water, spreads poverty and disease and causes a prosperous and populous region to revert to swamp and jungle.

In a deltaic region, the premature decline and death of old rivers or sudden rise and violence of new ones are natural features of the landscape, intersected as it is by a maze of rivers, spill channels and sub-channels. Flood discharge in the area of deposition gradually raises the margins of the active streams until these serve as ridges or low flood embankments, confining them to their permanent channels and excluding overflow. As the river beds consequently rise higher, the river loses connection with the head-water, and languishes or dies along with some of its spill channels. On the other hand, the river may erode one of its banks in a curve or over-step or breach the flow embankment. As the country slopes away from the river, a new and active branch thus forms and rapidly develops, ultimately diverting the main river into it. A deltaic river also periodically oscillates between its permanent banks, and this also governs the activity of the off-takes of the river on its two banks. On one side we have extinct or moribund channels and on the other active land-building ones. Delta-building consequently goes on indefinitely in this manner through the deterioration of old rivers, characteristic of tracts where the anabolism of delta building has been completed and katabolism has set in, and the improvement of old rivers and emergence of new ones in tracts, which have yet to be built up and raised above the level of periodical inundation by the river system. Deforestation in the catchment areas of rivers, premature swamp reclamation, canalization and other interferences with

the river and drainage system, such as the construction of marginal embankments, *bandals*, roads, railways and bridges, profoundly affect the regime of the rivers. These speed up the decay of some rivers and cause others to rise into sudden prominence, disturbing the natural anabolism and katabolism of delta construction.

Slow, long-period changes that occur in the forests, meadows and marshes in the up-river areas, violent floods and earthquakes, periodic oscillations of the parent river channel between its permanent banks and the beheading of original rivers by their tributaries or their rivals largely explain the meandering of rivers which have important consequences on the agriculture and economic life of riverain tracts where population is dense. Therefore location and the current stage in the development of the rivers and their valleys govern materially the conditions of the pressure and distribution of population as well as the silting up of ancient channels due to natural or artificial causes. Sometimes a river that has completed its cycle from youth to old age begins its activity over again owing to some earth movement. The Brahmaputra is a sedate, ancient river in parts of Eastern Bengal, bringing water-logging and decadence, but in Northern Bengal it is a youthful, mighty stream and has re-sculptured the landscape and fashioned a new prosperity dating not further back than the last century. Such tributaries of the Ganges as the Kosi, the Mahananda, the Tista and the Damodar, also have changed their courses phenomenally, with consequent effects on land-forms, and through these on agriculture and the distribution of population.

Sometimes, again, as a river slowly builds up and raises the level of low land, there is slow or sudden subsidence of the entire area due to the increasing weight of forest growth or rural settlement on the plastic clay, and then the activity of both river and man begins afresh for

delta-building. That there has been earth subsidence in the delta is amply proved by the existence of a great *bil* area, which stretches from the Twenty-four Parganas across the north of Khulna to Faridpur and Bakarganj districts in the east. Such basins or *bils*, which are deep and impenetrable, form a long and an almost continuous chain and sometimes yield from beneath their surface fragments of large trees, brick foundations and skulls. Due to subsidence the *bils* were cut off from further accession of silt from active rivers and became in the course of years more and more depressed. That this subsidence is recent is indicated by the fact that the *bils* are now more extensive than they were in Rennell's time in areas where the river courses have not appreciably changed. Here and there in the Sundarbans area where excavations are made, fragments of trees are discovered in the position they must have occupied while growing many feet below the present ground level, while the remains of an ancient forgotten culture, of tanks, temples and palatial buildings now and then see the light of day amid muddy mangrove swamps.¹ The Sundarbans have been depopulated by some swift subsidence. Perhaps the entire area is liable for seismic reasons to a sudden subsidence like the strip of area in north Bengal and Bihar, where the earthquakes of 1897 and 1934 produced *bils* and changes of land levels and even of river courses. Since Rennell's time coastal erosion or submersion also has taken place. In Noakhali the sea had advanced and receded seven or more miles at intervals. It is estimated that after a steady rise the general sea-level has again fallen perhaps twenty or thirty feet in the last twenty centuries. Some aver that an earthquake or subsidence is also responsible for the 'Swatch of No Ground,' that vast depression in the centre of the head of the Bay of Bengal about 15 miles

¹ *Vide* The Gangetic Delta, Calcutta Review, March, p. 1859.

from the coast.¹ Had the ground on the sea surface not sunk gradually as it received more and more of silt deposit from the great rivers, a colossal delta would have been piled high above sea-level, and Central and Western Bengal would have gone to ruin, like the Midnapore delta on the west of the Hughli estuary, much earlier.

Bengal Rivers, Old and New. Until probably the 12th century the Bhairab, now almost reduced to a long chain of stagnant stretches of water covered with vegetation, and, subsequently until the middle of the 16th century, the Saraswati, now a forgotten stream, were the chief rivers of Western Bengal carrying the merchandise of the Province into the Bay. The Bhagirathi then rose into prominence, but after a century or so she began to decline along with the other Nadia rivers, sealing the doom of Central and Western Bengal, the rivers of Bengal concentrating their activities of land-reconstruction in the estuary south-east of the Bhagirathi. Until the middle of the 14th century the Brahmaputra hardly played any part in the economic life of Bengal for the vast waters of the mighty river poured into the Ganges near the sea-port of Chittagong. The maps of De Barros (1550) and Cantelli da Vignolla (1683) show the Caor or the Karatoya, which gave the name to the lower course of the Brahmaputra, flowing into the Bay not far from Chittagong. Three centuries later the main channel of the Brahmaputra passed through the district of Dacca, and carried the troops of the Moghuls, Arakanese and Portuguese for many sanguinary river engagements; but the river declined and changed its course. After alternate easterly and westerly wheelings, a definite westward advance of the Brahmaputra commenced towards the middle of the 18th century when the river chose the

¹ For an interesting discussion see Fawcus : Final Report of the Khulna Settlement, pp 4 and 5 and Sachse's note, p. 2.

channel of the Dhaleswari, which it changed, however, for that of the Jamuna after the Tista floods of 1789. The Brahmaputra's entry into Northern Bengal, which had been beginning already to experience the effects of the decay of several tributaries of the Ganges, here ushered, since the beginning of the 19th century, a period of unprecedented expansion of agriculture and population. A similar instance of the westering of a river is the detour of the Kosi, whose old beds are still discernible in the great lakes and depressions of Malda, and whose advent in Purnea and now in Bhagalpur has spelled agricultural disaster to these districts. The westward march of the Kosi, which formerly in its south-eastern course was united to the Mahananda and probably flowed into the Lohitya (Brahmaputra), and its junction with the Ganges first near Rajmahal, then at Colgong and finally at Naugachia, produced as much effect on the land and waters of Bengal as did the western march of the Brahmaputra. On the junction of the Kosi with the Ganges the united mass of waters opened the passage, now called the Padma. As the Padma developed she superseded the course of the Ichhamati that flowed into the Brahmaputra, and began an eastward march, discernible in the 16th century. Since then the old channel of the Bhagirathi began also to decay, the decline being especially manifest after the southern detour of the Damodar in 1770. The Bhairab and the Nava-Ganga, which were of as much size and importance in the central delta as the Bhagirathi was in the western before the change of the Ganges course, also began to lose their ancient vigour. But if the ancient Bhagirathi, Jamuna and Bhairab, which were most active before the Ganges changed her course, were declining, there were other mighty changes which were coming on. About the middle of the 18th century, the Ganges, strengthened by the entry of the Kosi in her upper reaches, forced new channels cutting right across the line of the Bhairab and running

south to join the Bhagirathi. The most important of these are the Jelanghi and the Mathabhanga or Churni, which played an important part in the fertilisation and drainage of the eastern parts of Murshidabad, Nadia and Jessore in the 19th century. These rivers, again, have declined along with the Bhagirathi as the Ganges gradually accommodated herself to the altered conditions caused by the enlargement of the Jamuna.

The Re-making of Bengal at the end of the Eighteenth Century. In the last three decades of the 18th century not less than six new rivers appeared on the scene, remoulding Bengal's economic history, viz., the Tista, the Jamuna, the Jelanghi, the Mathabhanga, the Kirtinasa and the Naya Bhangini. This revolution in Bengal's river system was due to the cumulative effects of changes in the up-river areas, the catastrophic inundations of 1769-1770 and 1786-1788 and the earthquake of 1762. Both geography and history were remade in Bengal as the 18th century drew to a close. But the drainage system of the delta yet showed a viable balance. As the Jamuna became more and more powerful with the flood waters from the Himalayas and the Assam valley, and tended to dam back the waters of the Padma, the Gorai, yet another new river—the youngest in the delta—came into existence between 1820 and 1830, giving relief to the Padma. The Gorai is called the Madhumati in its central and lower reaches where it captured an ancient channel, the Barasia, and it opened up its course across some of the old south-eastern running rivers such as the Kumar, the Nabaganga and Chitra, which consequently began to dwindle. In at least two portions of Bengal, in the north-east and south, the drainage has been reversed, smaller rivers are being absorbed and overpowered by the new rivers, the Jamuna and the Madhumati, which now, as Adams Williams well observes, “lay down a delta on a delta and run on elevated ridges

spilling over both banks.' In a yet large portion between Khulna and the Hughli the main effluents of the sweet water of the Ganges, which once were most active before the Ganges set out on its eastern course, are now dead or dying, having lost their connection with the main river and completed their tasks of land-formation and drainage.

The Intricate and Viable Balance of a River System. A river and drainage system is an integral whole. There is a nicely adjusted balance, albeit a shifting one, established among the various feeders, distributaries and channels of a river system. Even the numerous little water courses, which connect the rivers with the swamps or drainage reservoirs in the interior, and ramify through wide stretches of rice-fields, play their part in maintaining the balance between the inflow and egress of vast volumes of water during the rainy and dry seasons. The silting up of the bed of a particular river or change in its course, and alteration in the level of a drainage reservoir or of the tides have far-reaching effects on topography, agriculture and the river system as a whole. The eastward march of the Padma and the decline of the Nadia rivers hang on the western detour of the Kosi and the Damodar. The deterioration of the Bhairab, the Jabuna and the Kobadak, and the rise of the Gorai and enlargement of the Madhumati-Baleswar are connected with one another. Similarly the decline of the Atrai, the Karatoya and the Dhaleswari, the emergence and south-eastern trend of the Tista, the westering of the Brahmaputra and the eastering of the Padma, with the formation of the new channels of the Kirtinasa and the Naya Bhangini for uniting the waters of the Brahmaputra-cum-Padma and the Meghna, all hang together. The swinging eastward of the Meghna estuary is also dependent on these river movements as well as the banking up of the sea at the head of the Bay by the south-west monsoon, anticipated by the changes in the

position where the larger rivers, the Ganges, the Brahmaputra and the Meghna meet. Only half a century back the main stream of the Ganges flowed independently to the estuary; now she flows into the Brahmaputra about ninety miles above the mouth where the joint streams enter the Bay of Bengal. A century back the Ganges occupied roughly what is the bed of the present Arial Khan and flowed southward to the Bay. Now the Ganges has swung about fourteen miles to the east. A century ago the Brahmaputra, joined the Meghna in Sylhet and their mingled waters marched to the sea under Noakhali, there being unbroken land on their western bank from Vikrampur to Sahabazpur, as contrasted with the present broken land surface and new land formation in the estuary. Finally, each such change is aided by general deforestation and erosion, the extension of cultivation and reclamation of swamps, the diversion of vast volumes of water by a network of irrigation canals and the building of roads, railways and embankments. It is thus what goes on in the upper plain or in the distant mountains, forests, lakes and depressions reflects itself in the prosperity or adversity of agriculture in the down-river areas, in the silting up and change of direction of old rivers, in the emergence of new rivers, active in their delta-building functions, and, finally, in the estuarian conditions favourably or unfavourably for ocean traffic. Therefore a temporary or permanent change of river courses, premature senility or sudden rejuvenation of a river, due largely to deforestation, soil erosion, reclamation of marsh and irrigation in the up-river areas, determine the fortunes of agriculture and the distribution and pressure of population in the lower plains. In the different sections of a river valley the interests of agriculture and population expansion may be divergent; and the shifts of population and prosperity, that often accompany the changes of a river system, reflect the unbalance of man land and waters, that proclaims the recurrent defeat of man

at the hands of nature and the transient character of riverine civilisation.

Factors governing Agriculture and Population Movement.

The Ganges plain, again, forms a tropical region having a mean temperature of over 20°C., and receiving the monsoon rainfall. It is the fluctuations of the monsoon which determine agricultural prosperity in the greater part of the valley. The contrast between the dry upper plain, where the rainfall is irregular and does not exceed 35" per annum, and the delta, which exhibits exceedingly high figures of rainfall (100" to 120"), and never fails, is one of the most striking in the world of agriculture.

In the several diverse agricultural regions into which the Ganges Plain divides itself, water (rainfall, irrigational, or flood) operates as the chief limiting agent in agriculture and the growth of human numbers. Soil (old or new alluvium) through its effects on fertility also governs the nature and rotation of crops. The sub-soil water level (high in the old, or low in a young region) also determines the cropping (dry or wet) and methods of irrigation and cultivation. Along with land and river forms, extra-terrestrial phenomena such as sunspot and weather cycles, have an intimate bearing on the vicissitudes of man.

We may illustrate the field of riverine economics semi-diagrammatically, as follows :—

REGION	
<i>Biotic Factors</i>	<i>Forms of Exploitation.</i>
Man	Agricultural practice
Intensive agriculturists	Old alluvium
	New alluvium
	Flood plain
	Delta
	Crops
	Rotation
	Yield
	Security
	Irrigation practice
	Canals
	Wells
	Flood or flush irrigation
Agricultural regions	Communication and Drainage
	Roads
	Rivers and <i>Khals</i>
	Population
	Density
	Distribution
	Health
River Valley	Village Settlement
Physical factors:	Dwelling House
	Climate, soil, river form, etc.

Man's Crime against Trees and Waters. The Ganges plain is a regional entity, possessing what Vidal de la Blache calls an adapted and traditional "genus of life," that of the intensive cultivators. Such a "genus of life" has prevailed over a large territory, and attained a highly developed form, representing the connections and repercussions between man and the environment for centuries. The reciprocal action and interaction between man and the region is here consolidated, emphasising and increasing the present specific character of the 'region.' Man and the wider environment, indeed, have evolved together through mutual influences. Land, river, tree and man are by no means separate and independent factors, for by reciprocal influence they form a natural equilibrium, parts of which can be understood only in terms of the other. Such an understanding of regional interrelations will not only be

fruitful in the study of social causation, but also at the same time will promote that alliance of man with the entire range of ecological forces in which lies his real security and progress. How far does man, considered in his expression of population density, live harmoniously (symbiotically) with the ecological forces of the region? How far has he multiplied in numbers beyond the resources of the region that he occupies, thus setting narrower limits for himself, when nature is capricious? How far, again, has his ignorance or reckless disregard of the proper balance and rhythm in nature made poverty and ruin inevitable for future generations? These questions in regional economics have an enormous practical importance for millions of people, living in the dry areas of the upper plain of the Ganges, in the malaria-haunted hamlets of the moribund delta, and in the flood-swept settlements of the active delta.

Famine and flood equally publish man's crime against nature and nature's stern rebuke. Where formerly were arid wastes, man, by his skilful engineering and patient effort, introduces smiling fields. Where, again, there were bountiful orchards and fertile fields, man, by unskilful interference with natural drainage, brings about agricultural decline and epidemic disease. Everywhere man has thriven in numbers. Encroachment on the mountains by his tilled land has meant ruthless destruction of the forest covering, the effects of which are gradually but cumulatively apparent in decreased humidity of the air and equability of temperature, and lessened fertility of the region. When mountain slopes are laid bare, the erosive forces, no longer held in check by the slaughtered forest, hasten to destroy the soil cap on which the forest grew, thereby preventing further forest growth for generations. The mountain torrents, formerly harnessed for irrigation, now rush down as devastating floods, while the accumulated stores of mineral salts

in the mountain soil are scattered on the plains beneath, and fertile fields become alkali lands on which no crops can grow. Man, too, has gone to the brink of swamps and reclaimed marshes which are indispensable for maintaining the vitality of the drainage system. The loss of the periodical movements of water from the interior low lands to the main channels and *vice versa* alters the regime of the *khhals* and watercourses and upsets the drainage. The reclamation of low lands coupled with the continuous exhaustion of subsoil water reservoirs by means of thousands of alluvial wells, lowers the water level. The lowering of the water level depletes the pastures and certain crops are no longer grown; while there is great strain on bullock power for irrigation, especially in summer when fodder is scarce. As population and cultivation expand, the human masses and their cattle encroach on the jungle belt on the banks of the rivers. With the destruction of vegetation on the river banks, the forces of soil erosion under the heavy monsoon rainfall are given free play, and we have thousands of tons of fertile soil swept into the rivers, and extensive formation of semi-desert, inhospitable ravines.

Man's Invasion of the River's Domain. In the lower reaches of the rivers, increase of population leads to the construction of embankments, roads, and railways, which facilitate the silting up of river beds and the change of watercourses, leaving a legacy of soil exhaustion, water-logging, and fever for the next generation, if it can, to remedy. In areas where the rivers still exercise their delta-building functions, making and unmaking the landscape, man builds his settlement on the banks of a mighty river, but neglects to train the river and protect its banks. Then the river overflows and ravages the country. Man forces land into premature use in areas of the lower delta, subject to tidal influence, by constructing an embankment round it and utilising tidal action to drain

off water. The rivers and the network of *khals*, most intricate in their windings and inter-communications, are the natural lines of drainage, communication and transport by which agricultural produce from the interior of the country can be brought to the markets; but, as an engineer observes, "they are eventually destroyed by the system which they should serve." The loss of silt deposits gradually diminishes soil fertility. As the plough invades the swamps or drainage reservoirs, not merely are the natural storage basins of rivers reduced, but the free river spill and discharge through the numerous little watercourses ramifying along successive terraces of rice-fields are checked. The drainage channels soon fill with sediment brought in by the tide or during the rainy season and both scouring and flush irrigation cease, leading to the silting up of river beds, stagnation of water on the land and agricultural decadence. The rivers may yet rise and fall during the rainy and winter seasons, but the banks of the different grades of channel cease to fulfil their appropriate functions. Gradually all the watercourses get choked with silt and, on the other hand, the saline water brought by the tides being unable to spread itself is forced further and further into the interior. The net result is that the embankments have to be continually raised until the rivers cease to be able to carry off the drainage of the interior, which becomes waterlogged. If the embankments are broken, the saline water ruins the crops wherever it penetrates and makes cultivation impossible for many years until the salt has been fully washed out of the soil. This process and its serious results are now plainly discernible throughout the sea face of Bengal, in Midnapore, in the 24-Parganas, in Khulna, in Bakarganj and in Chittagong.¹ Under natural conditions

¹ Jameson's Note appended to Fawcus: Final Settlement Report of Khulna, p. 184.

a waterway is always exactly proportioned to the volume to which it is required to give passage. Man's invasion of the river's domain upsets the whole drainage organisation. An obstruction or prevention of the tidal flow and water-logging not only bring about agricultural deterioration in the course of years but also enable the anopheles to breed and multiply, and malaria becomes endemic, destroying or debilitating the population. Cholera also becomes a periodic scourge when the flood is low and there is no flush or drainage. Further, obstruction in the channels considerably raises the high-tide levels in the estuaries as well as in the upper reaches of the larger rivers, and bores become a menace to the riverine people. Pressure of population has thus led to a premature utilisation of low-lying land and marsh by methods, which have interfered with Nature's processes, and which ultimately redound to the ruin of the river system and the marsh-dweller alike. Man, if he wishes to control nature, must to a great extent follow her, for she has her own wisdom. If he seriously disturbs the balance and rhythm in which nature delights, her vengeance often follows quickly and man has no escape.

Co-operation in the conservation of land, in the use of water, in forest management, in the training and management of rivers, and, finally, in the reciprocal relations of village and city must be the keynote of the future. Throughout the ages man has despoiled the earth, and sinned in ignorance against waters, trees, and animals, thereby releasing destructive forces, which have impoverished and ultimately ruined his civilisation even in the most favoured regions. Man's future advance lies, indeed, in a bio-economic co-operation, based on scientific study and comprehension of the complex web of life that comprises both the animate and the inanimate realms; and this is deeper and more far-reaching than co-operation merely within the human community.

CHAPTER II

THE GIFT OF THE GANGES

Physical Features of the Ganges Valley. Egypt has been called "the gift of the Nile." No area, however, in the world, not even Egypt, has been so conspicuously dominated in its history and its economic and social life by a river as the valley of the Ganges. The direction of this mighty river has governed the course of ancient migration and conquest, as well as the modern distribution of population and prosperity. The whole of the Ganges valley may be pictured as "a series of large belts of country laid out flat like a section of soil strata, exhibiting the upper and more fertile silt deposit towards the east. Almost everything enters the region at the north-west boundary and runs through it south-eastwards. Natural regions, rivers and the distribution of population follow the same pattern." ¹

There are three reasons why the Ganges plain has been one of the earliest seats of civilisation, and today presents some of the world's highest records of aggregation that can be supported by agriculture. First, throughout the centuries the Ganges has not departed materially from its main channel—a constancy which differentiates it strikingly from the great rivers of China, whose wayward courses have militated against a dense and permanent aggregation. Secondly, the Ganges has found in the Himalayas, covered with perennial snow, an unfailing reservoir, making it possible for nearly half the total cultivated area of the

¹ Hunter : *The Indian Empire*.

drier portions of the valley to be irrigated by means of canals. Within less than 200 miles from the glacial ice-cave of its birth, known as the Gomukhi, the stream has been harnessed at Hardwar, where almost the whole volume of waters has been diverted towards the wheat, cane and cotton fields of the upper Doab. Thirdly, the Ganges valley is not only one of the most fertile plains of the world, but it is also within the influence of the south-west monsoon rains. Both the rich alluvium as well as abundant rainfall in summer explain the phenomenal agricultural productivity, and high density of population, of this favoured valley. Moreover, wherever rainfall is deficient or precarious, the small depth of the water-table has led to an easy and cheap system of irrigation by means of percolation wells, millions of which are at work throughout the alluvial plain. While the upper portions of the plain, which suffer from deficiency or irregular distribution of the monsoon, show us the world's most elaborate system of canal irrigation, the central portion of the valley exhibits the world's most marvellous system of alluvial well irrigation, and the delta is provided with the world's largest natural system of flush irrigation.

Riverside Life and Agriculture. Towards the delta the more certain and abundant rainfall of the Bay current ensures agricultural wealth, and instead of canal and well irrigation we have the natural system of basin-irrigation. Here agriculture and population respond not merely to the sequence of floods of the Ganges, called here the Padma ; but also to those of two other great river systems, the Brahmaputra and the Meghna, which pour their volumes of silt-bearing waters into confluence with the Ganges. The waters here widen out into endless vistas, and the lands are in a process of perpetual building and unbuilding by a wide and interlaced network of canals and streams, while an endless procession of cocoanut-clad villages and itinerant

hamlets, containing a swarming population, fringes the marshes or the river-banks, which are higher than the surrounding country, and are always accessible by water. Fishes are abundant here throughout the year, and the paddy-lands extend right up to the doors of the peasants' huts. Man here is essentially a child of the rivers. His crops and farming practice are closely adjusted to the timely inundations of red water ; and, indeed, if the rivers do not rise in flood, and submerge the country, he will be a fish out of water indeed. He has discovered a variety of paddy, which shoots higher and higher as the flood-water rises and submerges the entire landscape. When sand-banks are uncovered, he sows seeds by supporting himself on a raft of bamboo or grows some quick-growing vegetables, still maintaining his connection with the parent village by means of boats, and leaving the settlement when the wayward river drowns his fields and leaf-made huts. In the interior he ploughs his fields with buffaloes on standing water, reaps his harvests often in breast-deep water, and goes for shopping on earthen tubs or plantain rafts along the innumerable creeks that intersect the country. His traffic and transport are determined by tides and winds, and he himself lives a more or less amphibious life. The peasants' cottages here are found in isolation from one another on sites, which have been artificially raised above flood-level, or built on mounds of earth, separate islets, amidst *bils* or marshes, which are partially dry and covered with rice in the cold weather, but which during the rains form an almost unbroken fresh-water sea bordered by the river-banks rising only a few feet above the flooded country. These are very different from the hamlets of Western Bengal and Bihar, clustered together in congested sites, along the banks of the rivers or in their neighbourhood, where there are ridges of comparatively high land and of considerable extent. The contrast with the compact settlements of the Upper Ganges

plain, situated in the midst of bare treeless levels, and packed with population that has lived for generations on the same congested site, is even greater.¹ Not merely agricultural geography, but also race and history, have played a part in determining types of village settlement. Even in the same Province, we find the settlement of villages and distribution of fields differing according to agricultural tribes and castes. In the United Provinces, for example, towards the west we have large and compact village sites and large holdings as contrasted with scattered homesteads and small holdings in the sub-Himalayan east region. Not merely the contrasts of wheat and rice cultivation, but also the differences of race, as for instance, between the Jats and the Gujars, on the one hand, and the Kurmis, the Ahirs and the Bhars, on the other, have entered into the determination of the type of village settlement. It appears that the Rajputs, Brahmans, Kayasthas, and other high castes, have a preference for living in contiguity throughout the Ganges valley; while the Munda-Dravidian communities, the thoroughbreds of the soil, whether the Bhars, Pasis, Chamars or Dosadhs of the upper plain or the Mahisyas, Pods and Namasudras of the delta, would live in scattered clumps of houses on the brink of marshes or swamps, still fighting with the forests and the waters to which they are driven by successive invasions of new settlers. The dwelling-house also exhibits marked contrasts in different parts of the plain. In the delta, the huts are built on raised plinths and constructed of bamboo or reed frame-work, heavily plastered with mud and thatched with straw; while the entire hamlet is enclosed by a wall of bamboos or areca or *mandar* trees serving as protection against inundation. In Western Bengal, the thatch is thicker, or sometimes the roof is made of tile or

¹ See O'Malley : *Census Report of Bengal*, 1911.

corrugated iron, and there we find far greater use of wood and finer artistic decoration than in the delta, on account of greater security against inundation. In the Upper Ganges plain, the houses are mud-walled huts plastered with straw and cowdung to impart solidity. The roofs are made of mud and are flat, having none of the curvature of the thatched huts of Bengal, which is especially adapted for withstanding the heavy rainfall. The contrast between straw-thatched cottages and huts, with walls and roofs of mud, has its roots in the difference between the luxuriant forest-growth of the rain-inundated delta and the prairie in the Upper Ganges region, while the scattered hamlets of Bengal and the compact and congested rural settlements in the upper and middle plains mark the difference between a relatively new and uninhabited landscape and the mature and ancient valley, thronged with population for centuries.

Man in the Delta. Beyond where the active delta-building rivers meet the sea we have an intricate maze of sea-creeks, lagoons, islands and dense forests. Man here has to fight with fevers and brackish waters, with crocodiles and tigers ; he establishes his settlement along the banks of the smaller streams to escape from the danger of sudden inundation. At the outset he lives in *tongs*, or temporary sheds thatched with leaves, which are generally two-storied and built on platforms so that he may be safe from the attack of the tiger that prowls beneath. The tide of reclamation usually follows the course of the creeks that open themselves into the rivers; while the *khhals*, which communicate with them, and which run far into the midst of the clearances, are dammed to prevent the ingress of the salt water from the sea. A system of intermittent cultivation, aided by the hunter, the wood-cutter and, above all, the priest, who presides over their safety, through his supposed supernatural influence over the beasts of the forest, is the general rule, and both the harrow and the

plough are for the first few years inadmissible. But this is gradually replaced by a more intensive system of farming if fevers, *nal* reeds, and storm-waves have not taxed too much the reclaimer's energy. For each hamlet that gradually emerges with its fields of waving paddy and its groves of plantains, bamboos, cocoanuts and areca-nuts, we find three other hamlets that have been swept away like the shifting *chars* of the rivers. Perhaps the same hamlet would be twice washed away and twice resettled within the short period of two decades. Yet the river constructs as it destroys, and it is here in the delta that its power both for building and destroying are colossal, far outreaching man's feeble efforts to attach himself to the soil.

Course and Changing Life of the Ganges. From its source to the delta, the great historic river in its onward march has exhibited interesting contrasts of social and economic types. On the mountains where the torrents can hardly be utilized for purposes of irrigation, we sometimes find here and there in mountain fastnesses small and unstable hunting and forest tribes living on herbs, fruits, and wild game. The valley is here young and narrow, and its course is marked by falls and rapids, while its gorges, as for instance, at Sukhi, where the Ganges pierces the Himalayas, and at Lachmanjhola, are deep and steep-sided. From the great snow-bed, estimated to be 350 feet thick, at the foot of the Himalayas, near Gangotri, at a height of 13,800 feet above the sea-level, to Bhairogati, a distance of only 7 miles, the average descent of the Ganges is 255 feet per mile. From Gangotri to Hardwar the river drops to 1,024 feet above sea-level in a course of 180 miles. This may be compared with the slight drop, for instance, between Benares and the delta-head (a distance of 461 miles) of only 5 inches per mile approximately. In the course of the river's descent from the hills shepherds and flocks appear on the scene and thrive on the more abundant

pastures in the wide inter-stream spaces. Yet the community is still nomadic ; for, when the winter snow covers the entire vegetation, there is wholesale migration from cold to warmer levels, not merely in search of pasturage, but also to carry on some kind of intermittent cultivation. In the higher reaches of the river agriculture and pastoral life thus alternate in response to the cycle of the seasons and of vegetative growth. When we come further down the river, at the junction of the valleys we have periodical fairs, markets, or pilgrimages in which forest products or woollen goods are bought and sold and religious rites ceremonially observed. Temples and towns also arise and are located in the narrow belt of land between the river and the base of the hills. Water-power is here easily available and is controlled not in the primitive fashion of old days, but by methods of applied science, and the river can also be utilised for purposes of irrigation of distant and lower valleys. The Upper Ganges Canal starts at Hardwar, and at Naraura the Ganges is tapped again for the Lower Ganges Canal ; both irrigation and hydro-electric works, which are among the largest in India, are now functioning in the upper reaches of the river. The normal flood discharges at Hardwar is 207,000 cubic feet per second. In another 1,000 miles the river collects drainage amounting to 1,800,000 cubic feet discharge in flood-time, so that its maximum volume is greater at this point (400 miles from the sea) than that of the Mississippi at the end of its course.¹ The maximum discharge of the Nile at Cairo is returned as only 362,000 cubic feet. Further down, the valley broadens and the divides become sharper, though on account of steep slopes and easily washed soil agricultural conditions remain yet unfavourable. This is the stage of the valley's early maturity. Further downstream

¹ Holdich : *India*.

the Ganges becomes a broad shining river, meandering sluggishly across the plain, and on its banks stable village communities are found, and at the confluence, or where the river is easily forded, great cities have grown. The valley now shows advanced age and becomes flat, the banks merging imperceptibly in the plain. The river no longer cuts its bed, but deposits fertilising material, which is responsible for phenomenal agricultural productivity. The upper portions of the valley are less mature than the lower. Here the soils naturally have to depend on the artificial supply of manures to maintain their fertility, as compared with the new alluvial soils towards the delta, which are periodically replenished by silt deposits. Both the increased pressure of population as well as the necessity for irrigation have kept alive in the upper portions of the valley a tradition of co-operative habits and practices in connection with agriculture. Given artificial manuring and irrigation, the standard of farming is much higher and the cropping more variegated in the upper and middle portions of the plain than in the lower, while the social cohesiveness also is much greater. Compact village communities, with their strips of land scattered in different soil blocks of the village, are to be found in the north-west rather than in the east; and, in the gradual welding together of diverse tribes and stocks, function or the stage of economic development, rather than race or culture, serves as the basis of social gradation. Further, in the true and active delta, where the reclamation of marshes and forests is comparatively recent, we find not the autonomous type of village organisation, as in the north-west, but the feudal system of landholding, characterised by subdivision of superior proprietary rights in land, which has contributed not a little towards the lowering of the economic status of the peasantry. Like village tenures and rights in land and water, crops and density of population all vary in the different

parts of the river system. Such variation is connected with the close adjustment to soil and water-supply that the enormous multiplication of population has brought about.

Agricultural Contrasts between the Upper Plain and the Delta. In the upper and middle plains, we have two distinct agricultural seasons, the *rabi* and *kharif*, the agricultural time-table being governed by the conditions of monsoon rainfall and facilities of irrigation. In the lower valley and the deltas both rainfall and the sequence of floods govern the agricultural routine. In the active delta the smallest details of cultivation and human establishment are arranged, as in Egypt,¹ not merely in spite of but in expectation of the rise of the Ganges (or Padma) and the Jamuna, and in fact the fear of the people is lest the Padma, the Jamuna and the Meghna remain in their beds and the periodic flood of red-water should not rise high enough to submerge their fields. Again, in the upper course of the Ganges navigation is confined to the transport of timber, food grains, stone, etc., and has declined materially on account of the extension of railways and construction of canal dams. In the lower valley the Ganges may yet rank as one of the most frequented waterways in the world. The Sundarban route from the Hooghly river to Eastern Bengal is one of the most important highways of Bengal trade and contributes to the importance of Calcutta as a commercial city. As early as 1663 Manucci,² traversing the great river of Dacca on his way to Hughli was hard pressed for time and discovered this shorter and safer route to Hughli. He quitted the main stream and passed by the Sundarbans. During the flood season, when the whole country is inundated, the traffic on the Ganges and its tributaries, as well

¹ See Brunhes : *Human Geography*, p. 11.

² Manucci : *Storia Do Mogar*, Vol. 2, p. 87.

as on the numerous *khangs*, far outstrips that on roads and railways; the fishing villages on the banks of the rivers or at their confluences coming into prominence as among the largest river marts of the world. For the larger part of the year boats are used as the only means of transport in the countryside, for harvesting, for the distribution of the agricultural produce from the smaller *hats* and *bazars* to the bigger markets (*bandars*), and for all and sundry rural and urban business. Vegetables, clothes, potatoes, sugar, trinkets, and the luxuries of peasants, not produced in the countryside, are transported from one periodical market to another by dealers, who own their own spacious boats that move in the local waters throughout the year. In many instances the tide and ebb are utilised in the country boat traffic, and river-side marts become busy with transactions, that cannot last longer than the interval of the ebb tide. Boat-travelling, however, is very circuitous; while the tides run up and down the rivers and *khangs* in a very perplexing manner, many of the cross-rivers and *khangs* having a double tide, *i.e.*, the tide flows in from each end and meets in the centre.¹ In the new *chars* and rural settlements fringing the Bay, life is precarious during the rainy season, the women and children are sent to villages in the interior, while the able-bodied men live in their second homesteads called their *doaliabaris* or in *tongs* and in *chouas* (huts built on poles) to undertake the seasonal agricultural operations. The inundation as it builds new mud banks or destroys old homesteads, tanks, orchards and cultivated fields is the uncertain source of riches or poverty, and in this fluctuating environment he who risks most often has most. This makes the population, made up chiefly of emigrants from the rest of Bengal, speculative and full of daring and adventure; while the flood waters that destroy all marks or boundaries

¹ Beveridge: District of Bakargunj, p. 9.

between the fields are indirectly a constant source of family and village feuds and fights. Where the oscillations of the rivers are extensive and land formation quick and incalculable, alluvion and diluvion laws fail to secure justice, and rioting follows as a matter of course in the wake of *char*-building and un-building. The record of rights, which soon becomes out of date, indirectly fosters an appeal to arms. We read in the Settlement Report of a deltaic district : " The rivers fall rapidly and rise as rapidly. The new land is often very extensive and the locality of its formation can never from year to year be anticipated. As soon as the river has receded the land is ripe for cultivation and, if any delay occurs in transplanting into the liquid mud which the river has left, there is great danger that the river will rise again too soon for the crop to be harvested. The situation is conditioned entirely by the rapidity with which agricultural operations must begin on the land covered by water. It is this rapidity which makes determination of rival claims untenable before the cultivators have fought for the land." ¹ Thus the history of the *chars* of the lower delta is often such that turbulence and rioting must be linked with the conditions of local geography.

The constructive or destructive phases of the deltaic rivers are not confined to the new *chars*, swamps, and lowlands, but affect many of the important towns of Lower Bengal. The rivers, active in the delta, have sometimes played havoc with human settlements, which had fringed their banks, whilst they gradually raised the level of their beds and sought new channels. Capital cities, far-famed ports, busy marts, and thriving villages have been destroyed ; and here and there along with the remains of ancient cities on the backwaters and marshes or buried in river-beds, we have also lakes like the *Chalan Bil*, *Bhandar-*

¹ Faridpur Settlement Report, p. 56.

daha, Madaripur, Dhol Samudra, or Arialkhan formed, when the river abandoned one of its meanders by cutting a more direct channel during severe heavy floods. Apart from these lakes and backwaters, which form as a natural result of the delta river abandoning its old channel, there are in the delta marshes or permanently flooded areas of lowland in the interior on either side of the river forming the drainage swamps of the country. South of the districts of Faridpur, Jessore and Bakarganj, we have dreary and unwholesome swamps in whose centre the peasants with great perseverance and toil have raised large hillocks whereon they have built their homesteads in the dry weather in order to preserve their cattle and goods during the high inundations.¹

During high flood in the rivers, water not only pours over the banks into the swamps and depressions, but also backs up through the *khals* or discharge channels until the level in both drainage basins and rivers is the same. This time silt, often in large amount, is deposited in the *khals*, swamps and lakes as well as in the submerged country, filling up gradually all depressions and creating new land. When the water-level of the river falls, the rush of immense volumes of clear water, contained by the spill-basins during the flood season, into the river clears out the channels effectively. The open country beyond, which had received fertilising deposit at the height of the flood, now becomes a stretch of rice-fields through which *khals* wind, finally opening themselves into the *bils* or low-land areas. In the tracts subject to tidal influence, the alternating periods of flood and low-water are recurrent daily and every fortnight, while during high floods the volume of water which moves from the river through the *khals* or discharge channels and back is far greater, reaching the distant spill areas.

¹ Well's Account of Faridpur, Census Report of Bengal, 1871.

Agricultural Adaptations. It is the height and duration of the floods and the maturity or immaturity of the sand-banks, which determine the particular variety of rice crop that is grown in a flood plain. Thus the alternate flooding and discharge are intimately connected with the cropping and peculiar farm practices as well as the drainage of the country, the spill-basins of the interior forming the most vital part of the whole system.¹ Both the methods of cultivation and drainage in the active delta region, which depend on the process of flush alternating with flood, are, indeed, strikingly different from those in the upper and middle plains. Whilst the Ganges marches majestically from the glacial ice-cave of its birth to the sea, each stage in its course exhibits a distinct genus of life, with its characteristic social and economic traditions.

The Ganges valley is, indeed, divisible into several natural entities where agriculture and population respond as plant communities do to such ecologic factors as water (rainfall, irrigation, or flood), or nature of the alluvium. No better instance of this adaptation can be adduced than the fact that there are altogether several thousand varieties of rice in the plain adjusted to conditions of soil, climate, and the level of flood-water. Many of these varieties are so meticulously adapted to their localities that if interchanged one may not grow at all on the fields where another has thriven for centuries. Similarly, the farming practice differs strikingly from region to region, even with reference to the same crops. Along with differences in cropping, village settlement and density, we have associated differences of occupations, and of social organizations. It is thus that the whole texture of man's social and economic life is interwoven with that of the river system. No river on the surface of the globe has dominated man's interests and

¹ See Bentley : *Malaria and Agriculture in Bengal*, Appendix III.

habits more intensively than the Ganges. None is considered more sacred and beneficent by the people that live and thrive on its banks. Yet none is freer to follow its own whims and caprices, which at times involve man and his smiling fields and old-world hamlets in colossal destruction.

Historic Reminiscences. If the Ganges has moulded the economic life of the people, the venerable river has played no small part in determining the vicissitudes of ancient history. The antiquity and continuity of the civilization of the Ganges depend largely on the perennial flow of the river and its tributaries, which have never dried up, and which, unlike the rivers of China, have never departed materially from their main channels. Therefore the successive waves of Mediterranean and Armenoid, Rigvedic Aryan, Mongolian, or Turkish invasion have all followed the route of the Ganges south-east. Invasions have been hindered, first, by the difficulties at the north-western gateway; secondly, by the natural barriers which divide Hindusthan from the Deccan and separate the coast regions of the east and west from the interior of the peninsula proper; thirdly, by the rise of fortified cities, and of states and principalities, along the Ganges and her tributaries, which invaders could not occupy effectively. Thus the invasions have been slow and gradual, and have affected the capital cities only.

Such gradualness of invasion, and the long period through which foreign conquests and cultural conflicts were sought to be adjusted, explain in large measure some of the distinctive features of Indian social history. While the effects of foreign conquests were visible in the neighbourhood of cities like Kausambi (on the Jumna), Prayaga, Kasi, Pataliputra, Champa, Gaur and Saptagrama, all situated on the Ganges, the social life of the people as a whole was not materially disturbed. On the other hand, the vastness of the plain and the difficulty

of a speedy conquest, especially towards the delta, indirectly contributed towards cultural and racial assimilation and exchange. It is along the great plain of the waterways that the Indo-Aryan and successive invaders have dispersed south-eastward down to Bengal and south-westward to Kathiawar and the Bombay Presidency. The great ancient, trade route, connecting India with Central and Western Asia, lay by way of Taxila. Taxila, therefore, was one of the most cosmopolitan cities of the East, the seat of an ancient university which attracted students from far-off countries. Along this great road marched the advancing hordes of Central and Western Asia, eager to conquer the fertile plains. It is not by accident that Peshawar (ancient Purushapur), Rawalpindi (near old Taxila) and Umballa are important British cantonments, placed on the highway of invasion from the north-western gateway. Chandragupta, the Maurya Emperor, pushed the frontier to the natural barrier of the Hindu Kush, which separated his empire from that of Seleucus Nicator, and gave India the only lasting peace she knew in the past. When this scientific frontier could not be maintained, and powerful kingdoms arose south of the Hindu Kush, India became the victim of a series of invasions. Even now the frontier question is one of great gravity, and the power of British arms has been subjected to severe tests in the face of the uncertain situation, now that the natural barrier is no longer controlled by the British. From the Punjab plain to the plain of the Jumna and the Ganges the road lies between the desert and the mountains, and is rich in memories of ancient battles, which governed the destiny of Hindusthan: Kurukshetra, Thaneswar, Panipat. The British army traversed the track beaten by adventurers, conquerors and empire-builders in previous ages when it conquered the Punjab and, again, when it reconquered Delhi from the mutineers. Delhi, the central city of Hindusthan, the imperial city *par excellence*,

the cradle and the grave of successive empires, lies towards the south-east on the same track, the natural site of an imperial capital and the centre of the struggle for the empire.

For access to the eastern plain the important strategic points were successively Chunar, Sikrigully, Buxur and the spurs of Rajmahal.

Historic Importance of Bengal. For centuries the immense wealth and resources of the delta were the lure of the foreign invader. The Moghuls described Bengal as "the paradise of India," while Aurangzeb went further and termed it "the paradise of nations." For foreign travellers from Ibn Batuta downwards, Bengal was the richest storehouse of natural beauty, opulence and artistic excellence. But while the delta attracted the conquerors it hardly gave them a permanent foothold. Bengal was in fact the home of rebels and of refugees, who fled from the wrath of the Emperor at Delhi or Agra. Humayun, Sher Shah, Shah Jahan, and Shuja,—each in his turn turned to Bengal for consolidation of power and found here a vantage ground of great strategic importance for fresh campaigns. On account of the natural defence presented by a network of rivers and water-courses, Bengal was virtually independent of the sway of Hindusthan after the Turkish conquest of Delhi, and later carried on a long-drawn-out struggle against the might and organisation of the Moghul empire. The forts of Kalinjar, Ajaygarh, Chunar, Rohtas and Monghyr and the passes at Sikrigully played an important part in the conquest and defence of Bengal through the epochs. The mountainous road across Jharhkhand to the plains of Bengal in the south-west was always full of perils to the invader. Even after the Moghul conquest the zamindars and potentates (the Barabhuiyas) of the lower and eastern districts maintained a large measure of autonomy, and when opportunities came tested the

strength of the Moghul viceroy often by guerilla raids and naval battles. Bengal's formidable list of rebels and patriots through the centuries, was replenished by her mighty rivers, miasmatic swamps and thick jungles serving as natural barriers, her maze of rivers and creeks, and her heavy rainfall and periodic inundation, which easily cut off an invading army from its supplies. The list had begun with Jarasandha and Paundra Vasudeva in the ancient historical tradition and continued in the Pathan and Moghul periods with Chand Roy, Kedar Roy, Pratapaditya, Mukundaram, Isa Khan, Feroze Khan and Sitaram Roy. It was only extinguished with the Burdwan and Vishnupur Raj, whose combined stand against the British was the last episode of Bengal's fight for independence. On the other hand, the innumerable islands at the mouth of the Bay and the labyrinth of rivers offered easy refuge and abode to the pirates who sailed up the Ganges and Brahmaputra to plunder cities and villages of the interior, penetrating as far as Bakla, Selimabad, Jessore, Hooghly and Hijli. Such piracy of the Portuguese, Maghs, Pathans, Arakanese and others continued down to the early years of the eighteenth century ; its memories are still preserved by many folk-tales and ballads of Eastern Bengal.¹

A special historical advantage of Bengal is of course presented by the racial admixture in her social composition. As the conquerors gradually settled themselves in the fertile level plains, the original inhabitants probably moved eastward to Bengal and south-westward to the forest recesses of Chota Nagpur and the hills of the Deccan Plateau. Thus the predominance of aboriginal blood rendered Magadha the headquarters of Buddhism, which naturally could not obtain its first adherents from the

¹ Dinesh Chandra Sen: *Vrihat Vanga*, Vol. 2, Chapters III and VII ; and Eastern Bengal Ballads.

Brahmanic people. The tendency of race intermixture has been strongest in Bengal. First, the small colonies of ancient Aryan emigrants settling among the aboriginal peoples intermixed with the latter. Secondly, the prevalence of Buddhism for centuries encouraged such intermixture. The strength of Buddhism in Kasi, Kosala, Magadha and Vanga was no doubt derived in part from the non-Aryan element in the population. As late as in the seventeenth century Burdwan became an important Buddhist centre, and one Ramananda Ghosh dreamt of re-establishing Buddhism in eastern India. Even now the traces of Buddhism that are found in Bengal and Bihar are to be seen among the lower semi-aboriginal castes like the Bagdis, Haris, Doms, etc., while the cults of Sahajiya, Aul, Baul or Balarami have still kept alive in Bengal the vital teaching of the mystic schools of a forgotten Buddhism. The "depressed classes" of Bengal are mostly the survivors of the mass of local folks, who were influenced a great deal by the Buddhist culture. This mixture of stocks has been very beneficial. The successive dominations of Northern India have, indeed, left an indelible impress on the physical and social characteristics of the people of Bengal, while a continuous infiltration of Mongolian stocks, cults, and institutions has gone on for ages along the valley of the Tsanpo and the Brahmaputra into Assam and Northern Bengal. This mixture of stocks, rendered necessary by the shifting of rivers and consequent movement of social groups, as well as by the easy access through the north-eastern gateway and across the seas, has been on the whole beneficial to the civilization of Bengal. Bengal has thereby received from time to time accessions of new blood and fresh traditions, contributing not a little to the variability and catholicity of her culture. The democratic traditions of music and art in Bengal, the liberal anti-caste and anti-communal outlook of the Vaishnavism of Chaitanya, the universal appeal of the Tantric discipline and

contemplation, the ideal of man-God in many popular cults, the apotheosis of man-woman love in Sahajiya or the rapprochement of Hindu and Muhammadan religious traditions in the Darveshi and other schools,—all testify to the wide-minded culture of the masses of Bengal, that not only hides in its bosom the derelict remains of ancient reformist cults like Buddhism and Jainism, but has refashioned these from age to age, true to the freedom of the human spirit, born under the blue sky and in the expansive fields and rivers of the Bengal landscape.

Another advantage was presented by her large sea-board and the favourable location of her river ports. Tamralipti, Satgaon, Sonargaon, Chittagong, each in its age developed international trade connections, which reacted now and then not a little upon Bengal's social and political life. From very ancient times Tamralipti, which seems to have flourished from the 7th century B.C. to the 10th century A.D., had maritime and commercial intercourse with Taprobane (Ceylon), Suvarnabhumi (Burma) and Kamboja (Cambodia), on the one hand, and the ports of the Deccan and the Persian Gulf, on the other. Inland Tamralipti was connected north-westward along the routes of the Ganges and her tributaries with Gaya, and through Gaya with all the important cities of northern India as far as Taxila, by way of which the ancient trade-route connected India with Central and Western Asia. The culture of Bengal, therefore, was not insular, and in fact her merchants and Buddhist missionaries frequently undertook journeys to Siam, Cambodia, Java, Sumatra, Ceylon, Burma, China, and to Arabia and Persia. Thus the civilisation of the Greater India has borne the marks of successive migrations and movements from the sea-board of Bengal and Orissa. The history of Bengal's seaports is a chequered one, inextricably interwoven with the changes in her deltaic system. Such changes are going on even at the present day, and will have

as far-reaching an effect on her commerce and industry in the future as in the past.

In modern times, the influence of sea-power on Indian history was demonstrated in Bengal by the ascendancy of the Portuguese, Dutch, French and English trade settlements on the sea-board, and inland on the rivers. When the British obtained mastery over the province by defeating Nawāb Sirāj-ud-daulah at the battle of Plassey, their success reacted very favourably on their struggle with the French in the Carnatic. By the vast resources obtained in the new territory as well as the opportunities of trade with the hinterland which a position of vantage in the estuary naturally gave, the British were enabled to maintain large armies, which helped them to overthrow Lally, capture Pondicherry, the French capital in the south, and annex the Northern Circars. In this manner the British conquest of India was greatly facilitated by their first ascendancy in Bengal, and indeed, the later wars fought against the country powers could only have been won by aid of the money and supplies obtained from Bengal, combined with the advantages of mastery of the sea and the Ganges route. This is but one of the many keys that geography provides to the political history of India.

CHAPTER III

AGRICULTURAL CONTRASTS IN THE OLD AND NEW DELTA

Wet Cultivation in the Delta. The climate of the lower Ganges valley presents a contrast, gradual and not sharp, with that of the upper and middle portions. The temperature is warmer than that of the drier regions of the upper Ganges valley in winter, but it is much cooler in summer. In the middle Ganges valley we already have passed the prairie region and come to the forested belt, though of course the human interference has led to the regression of vegetation to dry types. The country is no longer dry and brown, but moist and green. The grass lands disappear, and trees become more and more numerous. In the lower Ganges valley vegetation becomes richer and more luxuriant and the abundant rainfall is much more favourable for the wet-zone crop, rice. The fertility of soil of the Ganges delta annually renovated by silt deposit is proverbial. It has been maintained through centuries by nice adjustment of cultivation to physical conditions, and both crops and methods have hardly undergone any changes. In ancient Bengal paddy was cultivated in the same manner as today. A nursery was prepared and the seedlings were transplanted, as testified by Kalidas, the poet of Ujjain, who could not but be struck with a farming practice quite unfamiliar to him. Speaking of Bengal, he describes the peasants' wives, who while protecting the *sali* seedlings as they sat under sugarcane groves, sang the glories of their husband protectors. The yearly inundation of the rivers and deposit of fertilising silt led to an early rise of civilisation in the delta region. The situation of Egypt as regards its proximity to an early seat of civilisation, *viz.*, Mesopotamia, was undoubtedly of greater advantage. Bengal could be reached

only after traversing the whole region of the Ganges valley ; the sea-route in the Bay was full of risks. But the climate in Bengal was immeasurably more advantageous for agriculture. In Egypt the summer is very hot and dry, and soil temperatures of 55° - 70° C. are experienced. Thus in summer the land formerly remained fallow. When the Nile flood inundated the region, the land was given over to the cultivation of winter crops. Bengal has a much more abundant rainfall and equable temperature than Egypt. Thus over the whole region two harvests a year may be obtained from the same field, while independently of double-cropping the yield also is very great. In Egypt the triennial rotation is introduced now on a large scale by perennial irrigation, and there has been recently an enormous expansion of cotton, which is a summer crop as in the United Provinces, and is grown by means of irrigation. The following table gives the indices of aridity in different districts in Bihar and Bengal :—

Index of Aridity in Bihar and Bengal Districts.

Districts.	Density.	Mean Temperature.	Normal Rainfall.	Index of Aridity.	Percentage of gross cultivated area which is irrigated.
Patna	763	24° C.	47"	34.5	57.6
Purnea	405	23° C.	61"	46.2	1.3
Monghyr	517	24° C.	54"	39.7	18.4
Bankura	389	27° C.	53"	35.0	6.0
Midnapur	528	25° C.	58"	41.4	9.2
Mymensingh	776	23° C.	93"	70.5	4.1
Noakhali (mainland)	1,202	25° C.	120"	85.7	...

As we move further and further towards the lower portion of the valley, the climate gradually becomes damper, the difference between the mean temperatures in summer and winter agricultural seasons decreases, and the crops can be grown without water brought from wetter regions. The "index of aridity" indicates that we are in a forest belt,

under conditions which are most favourable for vegetative growth. In Bihar we have three growing seasons, while in Bengal the croppings are even four and five. Bengal is not only exposed to moist sea winds from the Bay of Bengal, which set in as early as February and penetrate further inland, but is also practically beyond the influence of the hot dry westerly winds that are so marked in the middle and westerly portions of the Gangetic plain. Such winds which play an important part in the vegetation and agriculture of the Gangetic plain are felt only occasionally and intermittently in Bengal. In the central and western districts where such winds are more evident, these are far less hot and parching than in the west, due to the moisture taken up from the surface over which these blow. But the highest temperatures of the hottest months, April and May, are recorded from these districts. In Eastern Bengal the hot season is somewhat moister and its temperature rather lower than in Western Bengal. The rainfall due to proximity to the Bay and the Khasi Hills is much higher than in Bihar or West Bengal. In Dacca division the normal rainfall is 81" and in Chittagong 97". The sloping surface of the hills causes the upward motion of the air current, and the rapid increase of rainfall in the eastern and northern districts of Bengal. The rainfall thus is unevenly distributed in Bengal. The average rainfall ranges between 50 and 75 inches in the south-west, centre and west, and between 75 and 120 inches in most places in the south-east, east and north. It is still heavier in and near the hills, and near the coast than on the plains farther inland. The lowest rainfall in Bengal is that of Bankura and Malda districts, where the rainfall averages 54 inches.

Alluvium, Old and New. The whole of the Gangetic plain is peopled at a high density, and certain portions have a very thick population. But the plain, although topographically uniform, is not similar from the point of view of

climate. It is rainfall rather than soil conditions, which for the most part govern agriculture, and condition population-density in the plain. The whole of the valley is of very old formation, and it is not before we reach the active delta that the soil factor influences density. Throughout the plain the alluvium consists for the most part of a sandy micaceous and calcareous clay. The main differences between one soil and another lie more in the average size of the particles than in their chemical composition, even the soils conventionally known as clays and heavy loams containing a large preponderance of silica in a state of minute sub-division. Such differences are attributed to the sifting action of the water from which they are deposited, the deposits varying largely with the velocity of the river-current. From the agriculturist's point of view the great bulk of the alluvium contains adequate quantities of lime, potash and phosphoric acid. The amount of nitrogen is small ; but in the agricultural seasons the process of nitrification is much more rapid than in colder climates, so that the small supply is more often renewed. In the middle and western plain the older alluvium is distinguished by the presence of nodular segregations of carbonate of lime (*kankar*) and concretions of hydrated peroxide of iron (*baribunt*). Soils in the lower plain are distinctly lighter in colour and denser than those in the western plain. Commonly substrata are found in well-defined layers of sand, clay and loam; but occasionally the soil may extend unaltered in colour and consistence to a considerable depth. The soils vary from drift sand to clays. In the delta the proportion of sand-silt and clay varies more considerably with the rivers which deposit them and with the point of deposition. In Bengal the new alluvium which may be regarded as the area of deposition can be clearly distinguished for the most part from the old alluvium which is the area of denudation. In the latter the peculiar physical condition of the

soil, accentuated generally by a deficiency of organic matter renders it in many cases almost impossible to obtain a really fine surface tilth for sowing operations. Accordingly these old alluvial soils are not cropped to any extent during the *rabi* season, when very little rain falls. Chemically these soils are characterised generally by a great deficiency of lime and phosphoric acid ; the amount of organic matter, and nitrogen present is also low. Bacteriological conditions do not, therefore, favour the growth of more than a limited number of crops. Of these, the most important are *aman* paddy, and jute, the physiology of whose nutrition is different from that of most field crops. In the active delta, the soils of the new alluvium differ in their physical condition from those belonging to the old alluvium. The new alluvium may itself be distinguished into the newer and older deposits. The older deposits usually consist of a rich loam-soil of great agricultural value. The newer deposits vary much in character according to the river which yields the silt. The Meghna, for instance, brings a large proportion of decayed vegetable matter from the swamps of Sylhet, and is relatively straight and slow. Thus sand-banks form slowly and gradually; but on formation they are so heavily laden with organic matter and nitrogen that they are able to bear a crop of *boro* paddy before they even emerge above the surface of the water. On the other hand, the Padma yields very often a fine sandy loam, which overlies a subsoil of almost pure sand. These soils are often deficient in organic matter and nitrogen. Thus it is not until the Padma sand-bank has emerged considerably above the level of water, that the alluvium acquires sufficient consistency to bear a crop. In the newer alluvial formations, besides these variations in the different rivers, the fertility increases down-stream according to the age of the new formation. This is chiefly because the rivers first deposit the lighter particles of sand, and the heavy clay held in solution

is left behind ; the clayey matter which naturally forms a more fertile deposit is deposited further down the river.

It is thus, that the three rivers Ganges, Brahmaputra and the Meghna along with their tributaries are building up different soils in different parts of Bengal, which are responsible to some extent for a variety of crops and farm-practices. Throughout the active delta owing to the superior physical condition and greater amenability to cultivation the soils are regularly cultivated and cropped during the *rabi* season. Here, again, the newer alluvium of the Meghna which is the youngest of the great rivers, being richer in organic matter and nitrogen is peculiarly adapted to the heavy cropping of wet varieties of rice. It is probable that when the land formation of Noakhali and Tippera is completed within the next fifty years, these districts will be found to maintain a higher population density than the districts fashioned by the two other rivers. An agricultural differentiation due to the Meghna estuary is already noticeable to some extent in Bakargunj, but this will take decades to manifest itself in sharp contrast. The difference, however, between the new alluvium in the active delta and the old alluvium in central and western Bengal, as representing contrasted types of soil, is quite apparent in the cropping as shown below :—¹

<i>Old Alluvium.</i>	<i>New Alluvium.</i>
Paddy (larger proportion of <i>Aus</i> than <i>Aman</i>)	Paddy and Jute (larger proportion of <i>Aman</i>)
Jute (to a small extent)	Sugarcane and pulses
Sugarcane (largely)	Oilseeds, e.g., linseed, mustard, castor-seed and til
Maize, jowar and other millets	Cereals, e.g., wheat, barley and oats
Pulses and oil-seeds	Tobacco.
Wheat and barley (to a small extent)	

¹ Bengal Administration Report. 1921-22, p. 5.

Crops and Irrigation Practices in Different Parts of the River Basin. For Northern India the classification of crops into "wet" and "dry" crops is universally adopted. The distinction goes into the roots of agriculture. Wet crops include rice, jute and sugar-cane. These are aquatic plants, which have been adapted by a long process of control and selection for human use. We have seen that as we travel down the Ganges Valley towards the delta, the wet-zone crops prevail more and more, and the dry crops—wheat, barley, millet, maize and gram—become less and less important. In Bengal rice occupies practically 75 per cent. of the whole cultivated area and jute and sugar-cane another 20 per cent. Now the wet crops not only need a more abundant water supply than dry crops, but they also require to be grown much nearer the water-table than the latter do. Most of the dry crops have long tap-roots, which penetrate deeply into the soil for food; while the wet crops have a surface root system, and thus can grow most successfully, where the water-supply is abundant and the sub-soil water-level very near the surface. The cultivation of rice is thus very unlike growing wheat or any other cereal in the upper Ganges valley. In the case of the latter, the land is ploughed, the seed sown broadcast, and then the agriculturist concentrates all his energy as well as his bullock power towards artificial irrigation so that he can get a bumper harvest. But rice is not grown in this fashion, except in a few uplands and in places where labour is scarce. To obtain full value from the crop, it is necessary to transplant the seedlings shortly after they have sprouted. Ploughing starts soon after the early rain has moistened the soil sufficiently. Next a few selected fields are sown heavily. While the seed is sprouting, other fields which are to contain the crops are prepared to hold water to a depth of a few inches, mud forming the base of the necessary embankments. When there has been sufficient rain to flood these fields, the labour of transplantation

begins. Armfuls of paddy are torn up from the fields, where it was formerly sown, and taken to the flooded fields. There a hole for each individual plant is punched, round which the earth is pressed, so that the transplanted plant can have a new lease of life. Every single stalk of the waving fields of rice is separately transplanted. This is how rice comes into being in the Bengal delta. It is the result of the labour of bare backs bent to a task which starts at dawn and continues till dark, day after day, in mud and water till the monsoon ends. Thus the monsoon is called the "Badantor" or back-breaker in the peasants' vocabulary.¹ In Northern India the monsoon relieves or ends the cultivator's toil; in Bengal it commences a period of toil so intense that there is a general sigh of relief among the agricultural labourers, when the last great thunder-storms announce that bright sunny days are coming again.

Rice must be grown in mud and water, and unless it is transplanted, the grain will be coarse. The roots of rice must continually be fed by the ingress and egress of silt-laden water. The investigations of Harrison and of his staff at Coimbatore in Madras on the gases of swamp rice soils have drawn particular attention to the importance of the oxygen supply to the roots of the rice crop by means of a slow movement of aerated water through the upper layers of mud in which this crop grows. The roots of rice must have a constant supply of oxygen. Since they are immersed in mud and water, the only way this substance can be provided is in solution in water which must move slowly through the soil. The natural flood or flush irrigation slowly changes the water and renews the supply of dissolved oxygen for the roots of rice. Similarly, jute exhausts and impoverishes the soil to a much greater extent than most crops; and, excepting in the case of *chars* flooded annually and very low lands, which derive similar benefits by

¹ *The Statesman*, October 5, 1927.

drainage, it is in very few instances only that it is grown in the same land for more than three years consecutively.

In the middle and upper Ganges valley, where dry crops are most important, irrigation for the *rabi* is most important, effective and economical. The *kharif* crop which includes rice, cotton and sugar-cane in a year of deficient or untimely rainfall cannot be saved in its full value by artificial water supply. Perennial irrigation has been provided for the upper Ganges valley by a network of canals commanding more than two million acres supplying water throughout the year but chiefly for the *rabi* crops in the dry season. In the middle Ganges valley, it is mostly by well irrigation that the cultivation of *rabi* crops is carried on. The distinctive sub-regions in the Ganges valley present characteristic types of irrigation. The world's largest system of canal irrigation exists in the upper Ganges valley, and the most magnificent system of well irrigation in the middle valley; in the delta we also have the world's most marvellous natural flood irrigation covering a vast alluvial plain, the most thickly populated area on the surface of the earth. In the Bengal delta, the annual flood or flush irrigation during the rainy season when the whole country appears to be almost submerged is the mainstay of rice culture. During the rains a branch delta-channel from the main river acts as a channel of irrigation. When the river is in flood, water from the river passes into these *khals* or streamlets, which wind through rice-fields in the interior of the country. After the rains, the current is reversed; and we find water from the interior of the country pouring through the different tributaries and streams into the main river. The *khals*, indeed, then act as the discharge channels, through which the immense volume of water contained by the spill basins during the flood season eventually passes into the river, after having deposited its silt and fertilised the land. As this huge volume of spill-water escapes,

tremendous scouring is produced in every *khal* or discharge channel through which it passes, flushing them out in a very effective manner. When the flood is very low, on the other hand, the *khals* become partly silted up as a result of it.

Under natural conditions, a deltaic river system, says an unpublished report, performs a double function. During low water the *bils*, *khals* and the central channel serve the purpose of drainage, carrying off water from the depressed land-surfaces of the lateral river basins ; but in the flood season the watercourses cease to be drains, and entirely reverse their action, taking on at this time the character of irrigation channels. From the *bil* on every side the country rises with considerable slope, and is intersected by an ascending series of drainage channels. The drainage towards the *bil* is along successive terraces of rice-fields, each a few inches lower than the next above it. The water is retained in the higher ground for cultivation by means of the little ridges or banks (here constructed of straw as well as of earth) common throughout Bengal. It is to this system of natural irrigation that active deltas owe their fertility. But this fact has attracted little attention in Bengal, so that the importance of maintaining free river spill from the point of view of agriculture has been almost entirely overlooked. Moreover, the other important function of the river spill in the delta to provide for the natural scouring out of water channels, has almost escaped notice, with the result that irretrievable damage has been done to the rivers in many parts of the delta, owing to the restriction of free river spill as a direct consequence of the construction of thousands of miles of embankments. These embankments have been designed either for the controlling of the rivers or for the purposes of railways and roads, but whatever their object, their effect has been the same, namely, in the first place, preventing the flood irrigation which formerly enriched the land and kept it free from

malaria, and, in the second place, disorganising the natural system of flushing or scour which is essential to delta channels, if they are to remain open. As a direct result of these embankments the soil of many districts has become impoverished, harvests have diminished and malaria has increased; moreover, silt and sand have accumulated in the beds of many of the rivers to such an extent that they have ceased to be active streams.¹

Delta and Rural Density. Thus the agriculture of the delta is far different from that of the middle and western portions of the Ganges valley. Crops, farming practices and irrigation are all dominated here by the wet climate, moist soil and annual flush alternating with flood, associated with the delta-building functions of the larger rivers. The population density, which always and everywhere corresponds to the proportion of twice-cropped to net-cropped area, is conditioned mainly by the state of the local river system, which provides natural irrigation to which the active delta owes both its health and productiveness.

	Percentage of area cultivated to total land area	Percentage of area cultivated to total cultiva- ble area	Percentage of twice-cropped area to cultiva- ble area	Mean Density per sq. mile
<i>Deltaic Districts</i>				
Tippera	69.2	95.6 138 *	28.2	1,197
Dacca	80.5	94.8	18.6	1,265
Bakarganj	80.2	89.9 113 *	7.3	834
Faridpur	78.0	90.5 113 *	10.5	1,003
Rajshahi	48.8	56.4 118 *	15.1	548
Noakhali	76.3	92.1 150 *	57.5	1,124
<i>Non-deltaic Districts</i>				
Midnapur	59.8	74.3	0.4	534
Birbhum	55.2	62.9	5.6	558

¹ C. A. Bentley: *Malaria and Agriculture in Bengal.*

The figures marked with an asterisk represent the total of the percentages of cultivated area found to bear summer, winter, spring and miscellaneous crops.¹

It should be pointed out in this connection that the early rainfall in Bengal is due to the hot weather storms, or 'nor-westers,' as they are locally called. Such storms are due to the interaction between the damp sea winds and the dry winds from the interior in Bengal and Assam, supplemented by the action of the hills in giving rise to vigorous, forced ascent. Eastern Bengal and Assam enjoy the largest amount of such rainfall due to 'nor-westers' though it must be remembered that these sometimes develop into tornadoes, which cause great destruction of life and property. The following table gives the distribution of early rainfall, month by month, in Bengal and Assam :—

	Normal Rainfall in inches		
	March	April	May
East Bengal	2·31	4·24	10·45
North Bengal	1·26	3·97	10·65
Assam-Surma	7·75	13·42	18·00
Assam-Valley	3·56	8·09	12·03

¹ The data used for this table are derived from the District Settlement Reports.

District	Density of population	Rainfall in inches			Percentage of cultivated area (excluding orchards and gardens) found to bear				Total of Columns 6 & 7
		March to May	September to October	Total	Summer crops	Winter crops	Spring crops	Miscellaneous crops	
1	2	3	4	5	6	7	8	9	10
Midnapur	534	8·63	11·32	19·95	17	81	4	0	98
Rajshahi	548	8·35	13·52	21·87	64	29	14	1	93
Faridpur	1,003	14·65	13·07	27·72	36	72	24	1	108
Mymensingh	823	17·96	17·90	35·86	64	53	38	1	117
Tippera	1,197	17·84	14·84	32·73	44	74	18	1	118
Noakhali	1,124	19·06	24·46	43·52	45	90	14	1	135
Bakarganj	834	13·45	17·73	31·18	12	96	8	2	108
Dacca	1,265	17·5	14·3	31·8	27·12	41·43	23·48	7·47	69·05
Jessore	576	14·0	13·4	27·4	30·52	42·14	21·20	6·14	72·66
Bankura	424	7·5	11·7	19·2	—	55	34	14	55

Rainfall and Rice Varieties. Among the crops it is the two most important varieties of rice, namely, the summer rice (*aus*) and winter rice (*aman*), which are the best index of agricultural prosperity and density. It is for this reason that the rainfall in the months from March to May and again for September and October rather than the total annual rainfall, which determines the fortunes of agriculture. Now, districts which enjoy an abundant rainfall, both early and late, can grow both summer as well as winter crops. Thus there is to be found a *correspondence between early and late rainfall and rural density.*

Aus paddy grows on relatively high land, and requires the least supply of water among the Bengal varieties of rice. Generally speaking it yields, however, the least outturn and coarsest grain. *Aman*, on the other hand, yields the finest grain, but requires abundant water-supply. The percentage of area devoted to *aus* is much greater in West Bengal than in East Bengal. On the other hand, the agricultural security, and generally the rural density in Bengal, increase with an increase in the percentage of *aman*. The *aman* crop grows on low-lying lands, generally clayey, and is *par excellence* the crop of the submerged delta. Thus the densely populated districts of Eastern Bengal devote 63-90 per cent. of their net-cropped area to this *aman* crop.

The *aus*, as we have seen, grows on high lands with a sandy soil, which are above inundation level, and requires much less water than most of the varieties of paddy. At the same time it is more dependent on the season and requires more attention in its cultivation. The usual time for sowing *aus* paddy is the latter half of May. Its dominance in Western Bengal districts is due to the moribund nature of its rivers and the absence of floods, caused by the building of embankments, roads and railways. When the monsoon rain fails or is irregularly distributed, the *aus* crop in these

districts declines, and we have all the difference between an indifferent and a bumper harvest. Thus an irrigation organisation on a relatively small scale, such as a pumping apparatus to draw water from *bil* or river or a tube well could mitigate to some extent the effects of failure of the rains by supplying small quantities of water at the particular season.¹ Bengal's land system has contributed in large measure to the neglect and disrepair of tanks for purposes of irrigation. Due to the premature senility or decadence of the river system, the expansion of the *aus* area in Central and Western Bengal, which population pressure necessitates, implies greater agricultural uncertainty, unless Bengal adopts the irrigation methods and practices of the rice districts in the upper valley. But the real remedy is to restore by some means or other the flush irrigation, which built up the agricultural prosperity of Central and Western Bengal in the past and on which the time-honoured routine of cultivation is based. The decline of both agriculture and public health has been due to the fact that the tract has been deprived of the rich red water of the Ganges, when it is in flood; and nothing will contribute more to create health and wealth than the restoration of the overflow irrigation which is so well suited to the Bengal delta.

In Eastern Bengal the inundation of the two river systems which makes the country one vast sheet of water restricts *aus* cultivation and is responsible for the predominance of the *aman*. The relative insignificance of *aus* in the Eastern Bengal districts is further emphasised by its supersession in the high lands by a money-crop, jute, which cannot be grown as successfully in the West Bengal districts for lack of sufficient rainfall.

¹ *Vide* Report of the Dept. of Agriculture, Bengal, 1927-28.

Comparative Table of Monthly Rainfall of the Eastern and Western Bengal Districts (in Inches)

	Midnapore (534)	Nadia (531)	Jessore (576)	Bakerganj (834)	Faridpur (1,003)	Dacca (1,265)
March	1·64	1·82	2·11	2·22	2·33	2·63
April	1·87	2·55	3·66	4·78	4·72	5·36
May	5·09	3·87	8·08	9·20	9·04	9·75
June	10·04	10·66	12·67	16·33	13·36	13·56
July	·89	19·32	12·20	15·60	11·40	12·84
August	11·91	16·57	15·94	13·62	14·08	13·14
September	8·62	8·03	8·55	11·15	9·29	9·76
October	3·87	4·38	4·89	6·26	4·74	4·6
Total for the year	58	56·4	66·03	82·31	71·72	74

Comparative Table showing Percentages of Net Cultivated area under Rice.

<i>Aman</i> Rice	77·13	14	54	84·7	72·1	56·1
<i>Aus</i> Rice	13·31	66	32	8·8	22·1	16·1
<i>Boro</i> Rice	·87	·07	2	·3	1·1	·9
Total	91·3	80·07	88	93·8	95·3	73·1

The Predominance of Aman in the Lower Delta. The dominance of the *aman* in Eastern Bengal implies less dependence upon local rainfall and more upon the rise of the rivers. The amount of the local rainfall during the early growing season (March to May), however, directly

influences the *aus* crop areas both in East and in West Bengal. This is shown by the following table :—

	Early Monsoon Rainfall (March to May)	Percentage of <i>aus</i> to net-cropped area	Order according to the percentage of <i>aus</i>
Noakhali			
(mainland)	19 06	45	2
Mymensingh	17 96	64	1
Tippera	17·84	44	3
Dacca	17·5	27	6
Faridpur	14·65	36	4
Jessore	14 0	30·52	5
Bakarganj	13·45	12	7

On the other hand, the amount of the early rainfall does not bear such close relation to the percentage of *aman* area. Drought does not affect the crop of the lower delta to the same extent as in Central or Western Bengal. The soil in many tracts retains a considerable quantity of moisture long after the rains have ceased. An early rainfall, however, is needed for both the *aman* and *aus* paddy as well as for the jute crop in order that the land might be prepared and the crop can grow properly at the first stage. When once the *aman* has got a start and the land in which it grows is inundated, the crop becomes almost independent of the local rainfall. The *boro* paddy is grown by the sides of *jheels* and on the edges of tidal rivers and creeks, and is either artificially irrigated, or is watered every time the tidal current comes. The state of things most injurious to crops in the delta would be a want of rain in the early months of March and April (Chaitra-Baisakh), followed by an early rise of the rivers; for then the sowing of *aus* and *aman* paddy as well as jute would be delayed and the late *aus* crop destroyed by the inundation water.¹ Thus floods are at once the

¹ A. C. Sen: Report of the System of Agriculture and Agricultural Statistics of the Dacca District.

support and the ruin of paddy. In a large part of the delta it is even somewhat difficult to classify paddy in the marshes as belonging to any agricultural season. Much of the *aman* rice might be classed as *aus*, and some of the *aus* as *boro*, as the dates for sowing and reaping are dependent upon the level of the water, which is convenient at very different periods of the year at different points in the fringe. The agricultural seasons also are far less differentiated in Eastern Bengal than in the West as agriculture depends more upon the duration as well as the height of the flood than upon local rainfall.

Some inverse correspondence is discernible between a small early rainfall (March to May) and the area under *aman*.

	Early Monsoon rainfall (March to May)	Percentage of <i>aman</i> to net-cropped area	Order according to percentage to <i>aman</i>
Bakarganj	13.45	96	1
Faridpur	14.65	72	3
Tippera	17.84	74	2
Mymensingh	17.96	53	4

Generally speaking, however, the above correspondence cannot generally hold good in the case of the deltaic tract, where the rain is never deficient or uncertain, and the flood is always available to ensure the success of *aman* cultivation.

It is significant that the early monsoon rain or even the total amount of rainfall bears no relation to the double-cropped area in the deltaic tract. Both the percentage of *aman* to the net cultivated area as well as the proportion of the cultivated area, which bears two or even more crops, increases, as we proceed along the two river systems more

and more towards the delta. This is shown by the following table :

	Early Rain	Total Rainfall	Percentage of gross culti- vated area, which is irrigated.	percentage of double- cropped area to cultivable area	Percentage of <i>aman</i> to net- cropped area	Density
<i>Inactive Delta</i>						
Murshidabad	7.98	54.99	16.0	17.2	...	656
Nadia	11.37	55.11	0.02	28.2	...	531
Hooghly	9.88	57.42	10.7	9.0	...	938
Pabna	11.93	59.43	...	30.5	120	795
Bogra	12.01	66.29	...	18.7	...	785
Rajshahi	8.35	56.80	1.4	15.1	29	548
<i>Upper Portion of the Active Delta</i>						
Dacca	17.5	74.72	...	18.6	41	1,265
Mymensingh	17.96	88.11	1.6	44.8	53	823
Faridpur	14.65	72.79	...	10.5	72	1,003
Tippera	17.84	81.92	...	28.2	74	1,197
<i>Lower Portion of the Active Delta</i>						
Noakhali	19.06	113.80	...	57.5	90	1,124
Bakarganj	13.45	89.29	..	7.3	96	834
Khulna	12.28	71.83	...	7.5	...	347

Significance of Summer and Winter Rice. Nothing can show better than the above table the importance of flood-water in the agricultural economy of the Bengal delta. We see from the above figures that the nearer we go towards the Bay, where the rivers are most active in building the delta, the greater the percentage of *aman*. The four districts,

which have the highest percentages of *aman* cultivation, have been gradually increasing their areas.

	Normal omitting '000	Area in 1933-34
Bakarganj	1,300	1,400
Noakhali	705	692
Tippera	803	834
Faridpur	668	722

The disparity of the percentages of double-cropped area between the upper and lower deltaic districts in Eastern Bengal is due to the fact that as yet no pressure of population has been felt in the lower deltaic tract, which is as yet less developed ; a district like Dacca or Mymensingh has reached high percentages of double-cropped area, because of high population density ; but these figures the districts in the lower reaches will sooner or later outreach as the population presses upon resources. *Boro* (spring rice) is a hardy crop, which is cultivated along the edges of *jhils*, *khals* or streamlets and in soft marshy lands. Now *boro* gives usually a heavy out-turn, and is most commonly grown along the banks and in the *chars* of the active rivers as well as in the swamps of Eastern Bengal, which occupy a large portion of the total area. The dominance of *aman* and *boro* explains the fact that at present the out-turn of rice in the fertile swamps of the active delta is half as much again as in the other parts of Bengal. On the other hand, in the moribund delta, the *aus* paddy which can grow on less amount of water-supply tends to replace *aman*. It has been estimated that between 1906 and 1920 the normal area under *aus* has increased by 10 per cent. in Jessore and by 50 per cent. in Nadia district. Nothing can show better the effect of the change from active to moribund deltaic conditions. It is also significant that in the less recent alluvial tracts of Dacca and Faridpur, which do

not enjoy the advantages of an annual ingress and egress of flood water, as the more recent ones do, *aus* is more prevalent; and when *aman* is grown it is ordinarily much poorer and only becomes satisfactory, when inundations come and are wide-spread.

Jute can be grown in almost any type of soil which has the necessary depth as well as sufficient water to keep the soil moist. A swampy soil and an excessively damp atmosphere are not necessary for its successful growth. In fact the finest jute in Dacca is grown on land which never goes under water. Jute grown on a higher level produces a superior fibre to that cultivated in low-lying areas. Thus, jute thrives well in most parts of Bengal, but best of all in the rich alluvial areas in Eastern Bengal, for it is an exhausting crop. On high lands, which are never submerged, or on soil not benefited by inundation silt, it is necessary to manure for each crop of jute.

The distribution of jute is as follows :

Eastern Bengal	64 per cent.
Northern Bengal	26 „
Central Bengal	8 „
Western Bengal	2 „

Some of the world's highest records of rural density have been reached in Eastern Bengal as a result of the dominance of *aman* and jute, along the tracts bordering the mighty rivers. The percentages of both these crops are much lower in Central and Western Bengal, where the delta has ceased to be active. Jute avoids not only the older alluvium or red laterite but also the salt-impregnated soils. Both for climatic and soil factors, the area of jute has not expanded beyond certain geographical limits in Bengal. As regards humidity and rainfall, we find that the cultivated area under jute and the average out-turn are much higher in tracts of higher humidity and higher early and late rain-

fall, as shown in the table below.* Thus Dacca, Mymensingh, Tippera and Faridpur, which all possess higher humidity and rainfall, are the best producers of jute in the Province.

	Percentage of gross cultivated area under jute		Percentage of yield for ten years, 1917-1927	Percentage of area under jute to the consolidated jute area in India*	Total (average) rainfall
	1921	1931			
Burdwan	·7	·4	83·1	·11	56"
Midnapur	·6	·4	70·1	·23	60"
Murshidabad	2·9	3·7	80	·79	55"
Dinajpur	4·6	6·9	77	2·18	71"
Dacca	18·0	22·4	80·9	10·2	75"
Mymensingh	19·6	20·8	83·2	20·3	88"
Faridpur	17·1	23·8	86·3	6·9	73"
Tippera	17·5	20·9	76	9·7	81·9"

* P. N. Sen has helped me with these figures.

Distribution of Humidity.

Distribution of rainfall.

February *	March *	April *	May	June †	July †	August †
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Early Rainfall (Feb. to May)	Rainfall (June to Aug.)
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Regions of small jute yield

Burdwan	71	67	74	74	82	86	92	9	33·3
Midnapur	68	62	69	74	82	90	92	9·6	35·4
Murshidabad	80	70	74	81	82	91	92	8·5	33
Dinajpur	80	69	72	79	89	90	90	10	43

Regions of high jute yield

Dacca	83	83	83	84	89	90	90	18·7	39
Mymensingh	83	79	81	84	89	90	90	24	47
Tippera	82	79	80	82	87	88	90	20·7	45·8
Faridpur	87	76	69·8	79	85	87	86	17·6	37·8

* Sowing season for jute

† Reaping season.

The importance of *aman* rice and jute crops in the active deltaic tracts of Eastern and Northern Bengal clearly indicates that the agricultural future of these areas may be seriously jeopardised as a result of the disturbance of the deltaic character of the landscape. Jute, which is a very exhausting crop on soils not replenished by annual silt depositions by rivers, will certainly decline; for the small holder will not be able to provide adequate manuring on high lands, which may grow jute and yet from which flood water is excluded. There is in fact already a tendency discernible for *aus* rice to take the place of jute in the less recent alluvial formations in Eastern Bengal. Jute is of course now being restricted throughout Bengal as a result of over-production. Again, the *aman* crop, whose area is about 15·5 million acres in Bengal as compared with 5·7 million acres only of *aus*, can thrive only where the periodic ingress and discharge of flood are not interfered with. The *boro* rice, of which the total average is 400,000 acres in Bengal, and which gives the largest out-turn, *viz.*, 15 maunds per acre on an average as compared with only $12\frac{1}{2}$ maunds per acre for *aus*, can be grown successfully only in the lowlands and marshes and on the sand banks of the active rivers. We thus see that the obstruction of periodical flooding in Eastern Bengal will militate against the factors, which are to-day responsible for its phenomenal agricultural productivity and rural density.

CHAPTER IV

POPULATION EXPANSION IN THE EAST

Region of Greatest Rural Density. The active portions of the deltas of the Ganges, Brahmaputra and Meghna comprise most of Eastern Bengal, and constitute the most populous and most productive region of the Ganges Valley. Not merely is this tract enriched, agriculturally speaking, by the activities of three different river systems, but also the average rainfall is more copious the farther we descend the courses of the rivers. Here both the double-cropped area and the area under the wet variety of rice increase, and co-exist with heavy rural density. It is here, in fact, that we find the most heavily populated rural areas on the earth.

The following *thanas* in East Bengal districts represent the world's highest records of rural density. They have a density of more than 1,300 persons per square mile, *i.e.*, more than four times the rural density which can be supported in Western Europe.

District.	Thana.	Density per sq. mile.	
		1921	1931
Dacca	Keraniganj	1,841	1,974
	Dohar	1,900	2,049
	Narayanganj	1,474	3,010
	Sonakanda	2,873	...
	Fatulla	1,586	1,571
	Baidya Bazar	1,474	1,505
	Narsingdi	1,307	1,301
	Munshiganj	2,347	2,329 *
	Rajabari	1,819	...
	Tangibari	2,681	3,044
	Srinagar	1,755	1,895
	Shirajdikhan	1,938	2,066
	Lohaganj	2,733	3,228

* The decrease is due chiefly to the transfer of certain *char* areas to other sub-divisions.

District	Thana	Density per sq. mile	
		1921	1931
Faridpur	Bhanga	1,357	1,502
	Madaripur	1,391	1,477
	Palong	1,561	1,640
	Lonesing	2,076	...
	Sibchar	1,420	1,381
Bakarganj	Jhalakati	1,410	1,562
	Bonaripara	1,459	1,698
Tippera	Daudkhandi	1,301	1,414
	Homna	1,348	1,547
	Bancharampur	1,437	1,622
Noakhali	Begamganj	1,306	1,545
	Ramganj	1,370	1,606

According to recent reliable estimates, the density of population in three regions in China, the Northern, the Yangtse delta and the Canton delta does not exceed 1,000 to the square mile. Similarly, in the plain of Chengtu, the scene of the most intensive irrigation in China, the density does not rise beyond 1,700 to the square mile. In China, this heavy density is accompanied by agricultural depression and migration of surplus labour, and by frequent famines, which tend to readjust the population to resources. In Eastern Bengal, on the other hand, the symptoms which indicate that the soil can no longer bear the pressure of population have yet to appear. The rural density may still increase, and the land can bear the increase with ease. That such a marvellous expansion of population in Eastern Bengal is very recent is indicated by the following description of the eastern districts, written in the middle of the last century: "In Hughly, Baraset, the 24-Parganas, Jessore

and Nadia, it is, generally speaking, one vast sheet of rice in the plain, and the fruit-bearing trees in the village. In other districts remnants of the real natural jungle remain. Such are the districts of Dacca, Farridpore, and Bakarganj. Beyond Dacca and Tipperah heavy tree jungle is to be met with. The hills of Chittagong are clothed with an almost impenetrable shield. To the east and the north the wild beast has often undisputed sway over whole tracts.”¹ It is rather striking that within the brief space of a century the disparity of agricultural conditions in the moribund and active delta has now brought about a marked contrast between the increase of jungle and fallow land in the once prosperous areas in the upper delta and a phenomenal agricultural expansion in areas described as covered with tree jungle in 1848.

Agricultural Conditions supporting High Density. To understand the agricultural conditions, associated with the phenomenal concentration of population along the Ganges and the Brahmaputra, we will analyse the employment of land in the three contiguous districts of Dacca, Faridpur and Bakarganj. In these districts land-formation has been recently completed by these rivers, and typical *thanas*, which are old or new alluvium, exhibit characteristic tendencies.

¹ The Plains of the Lower Ganges, *Calcutta Review*, Vol. IX, 1848.

Percentage to Net-cultivated Area of

		Aus	Aman	Jute	Twice cropped	Orchards and gardens	Population density 1921	Population density 1931
1. Dacca								
	Thana							
Old alluvium	1. Sibalay	24.2	63.2	15.0	54		740	796
	2. Harirampur	12.1	74.3	8.0	49	Figures	1,050	1,165
	3. Sabhar	14.6	45.9	20	33	not	686	752
	4. Kapasia	22.3	41.4	21	19	available	631	741
	5. Munshiganj *	6.8	34.0	44.6	32		2,347	2,329
	6. Srinagar	16.7	59.2	19.0	31		1,755	1,895
2. Faridpur								
	Thana							
Old alluvium	1. Pangsa	40	47	12	28	5	751	700
	2. Bhusana	39	75	15	39	8.7	703	702
	3. Madaripur	6	80	16	30	2.4	1,391	1,477
	4. Palong	20	80	17	33	11.0	1,561	1,640
3. Bakerganj								
	Thana							
Older alluvium	1. Gaurnadi	12.6	82.4	6.5	26.9	15	1,271	1,408
	2. Jhalakati	9.6	68.3	0.8	9.8	15	1,410	1,562
	3. Bhola	8.4	83.7	0.5	25.1	10.5	733	676
	4. Patuakhali *	8.3	89.5	...	9.1	5.0	801	819

* Sub-division headquarters.

Figures for the density of Munshiganj *thana* are swelled to a small extent on account of its being the headquarters of a sub-division, but they represent lower density than contiguous *thanas*, such as Tangibari or Lohaganj. Patuakhali, though it is also the headquarters of a sub-division, also shows lower density than most of the contiguous *thanas*. It is noteworthy that we have in these *thanas* more numerous families of the higher castes than elsewhere.

The following agricultural tendencies are noticeable :

1. Generally speaking, density of population increases with the prevalence of *aman rice*, which is the most productive crop in the lower delta. The proportion of *aman* increases in areas, where the inundation comes early and is wide-spread. Thus it expands as we descend towards the Meghna estuary. It is in Bakarganj that we find the complete dominance of *aman*, which accounts for phenomenal productivity and expansion of population. Here *aus* is either mixed with *aman*, or precedes it. The other crops are treated as catch-crops for land, whose main crop has already yielded winter rice.

2. In older alluvial tracts more remote from the silt-bearing rivers the proportion of *aus* is much greater than in more recent ones ; even here there is a tendency to supersede it by jute, which comprises different varieties and can grow very well on elevated lands as well as in depressions. In Dacca the best jute grown is cultivated on comparatively elevated loamy soil, or on the old red soil. In Faridpur, on the other hand, the best jute is grown in the *chars* and *jhils*.

3. The proportion of twice-cropped lands, considered with the existence of *rabi* crops, which are of little importance in East Bengal, and the absence of jute, indicate agricultural depression. This is the case of the old alluvium or old land raised in Dacca and Faridpur.

4. The last does not apply to comparatively new alluvium, in the basin of the river Meghna, which is now in an immature stage of development. Here *aman* thrives best, and when jute is added to paddy as an important crop, as in Tipperah and Noakhali, a higher density of population can be easily reached and maintained.

5. Orchards and gardens of betel-nut, cocoanut, etc., also contribute to high density. Noakhali and Bakarganj, in particular, grow fruit-bearing trees of considerable variety and in great profusion. The density of cocoanut trees per acre is, for instance, astonishing in some *thanas* in Bakarganj, e.g., Jhalakati, 39 ; Pirojpur, 38 ; Mehendiganj, 30. The following comparison will be interesting :—

District	Percentage of area devoted to fruits and vegetables to net-cropped area	Total area in acres	
		1931-32	1933-34
Noakhali	10·15	83,000	83,000
Bakarganj	9·45	165,000	168,000
Dacca	3·81	109,200	111,400
Mymensingh	3·74	69,700	69,700
Faridpur	4·27	57,300	46,600
Burdwan	·76	11,000	8,800
Nadia	·89	5,900	5,900
Jessore	·32	3,200	3,400

6. Where the land is of new formation and is not yet completely developed, density of population is small, especially in areas, which suffer from storm-waves of the estuary.

Some of the world's highest figures of rural density thus have been reached in Eastern Bengal as a result of the dominance of *aman* and jute crops along the tracts bordering the great rivers. The percentages of both these crops

are much lower in Central and Western Bengal, where the delta has ceased to be active. In the district of Tipperah the greatest density is in the *thanas* bordering the Meghna from Nabinagar to Chandpur.

		Density		Rice			Jute	Miscellaneous
		1921	1931	Summer	Winter	Spring		
Along the Meghna	Nabinagar	1,063	1,240	52·4	53·8	36·5	38·4	3·6
	Matlabazar	1,217	1,375	54·6	47·4	24·4	45·3	1·2
	Daudkhandi	1,301	1,414	53·5	44·8	30·1	45·1	2·3
	Chandpur	1,275	1,268	46·2	64·2	27·6	31·0	·2
	Homna	1,348	1,547	Not available				
	Bancharampur	1,437	1,622					

The last two *thanas* now show the highest densities in this district.

Here both jute and chili crops, in addition to rice, explain the high productivity and density.

		Density		Rice			Jute	Misc.
		1921	1931	Summer	Winter	Spring		
Inland	Chandina	881	1,033	62·6	93·1	8·8	5·3	·3
	Chaudagram	956	1,056	56·2	89·4	10·3	·2	·8
	Laksam	831	956	39·3	94·6	5·4	1·7	·2

Here the staple crop is winter rice, and is supplemented by summer rice. Jute is grown scantily and density of population is much lower. The density of population in Nasirnagar falls below 750, and the country cannot sustain a heavier density.

Agricultural Depression in the Older Alluvium. It is noteworthy that malaria and agricultural depression go together in the old alluvium in Eastern Bengal, as they do in the still older alluvium of Central or Western Bengal. The density of population on the outcrop of the old alluvium is on a level in Dacca and Mymensingh. The diversion of the Brahmaputra into the channel of the Jamuna has caused agricultural decline in the portions of Mymensingh and Dacca districts, where the old Brahmaputra has now become moribund; but the deterioration is not as striking as in Central and Western Bengal. Similarly, the parts of Faridpur, which adjoin Nadia and Jessore, suffer from obstructed drainage and agricultural depression, and their density is on a par with that of the two decadent districts. The Goalundo, Bhushna and Madhukhali thanas in Faridpur are as malarious as any part of Bengal. Goalundo, Rajbari, Bhushna and Pangsa are declining in numbers, while the majority of the *thanas*, free from this scourge, still exhibit figures of density. Were it not for the spread of malaria and jungle land in parts of the Goalundo and Sadar sub-divisions, the death-rate in Faridpur would be comparatively low. Now these areas only a few decades ago formed a part of the active deltaic region.

In those portions of the delta, where the building activity of the river diminishes, the river raises its banks so high that water can no longer spill over them even in the flood season. Often, however, as the result of artificial interference, such as the building of roads, railways or river embankments, the free river spill and discharge are prevented, as a result of which there is a great accumulation of silt in the channels of the rivers. It is thus that even when there is no natural decline of a deltaic river, the disorganisation of the system of lateral spill-basins, which maintains the vitality of the whole efferent system,

leads to the obstruction of watercourses sooner or later by silt and sand. It is in this manner that branch rivers in the new delta are decaying. Its causes are to be sought not in the affected channels themselves, but in the adjacent land surface of the delta, where the construction of the roads across the watercourses and natural lines of drainage has shut out flush and flood.¹ For this reason parts of Eastern Bengal are beginning to show decadent conditions, similar to those in other parts of Bengal. Embanked roads and railways, built whether in Western or Eastern Bengal, will bring about agricultural deterioration by interfering with the arrangement of flushing and scour devised by nature. It is true that some of the districts in Eastern Bengal as, for instance, Bakarganj have the smallest mileage of roads; but there is now a craze for the construction of roads also in the eastern districts, such roads being carried on high embankments and their alignments interfering with surface drainage and scour carried on by the intricate network of streams and *khals*. There are also recent schemes of extension of railway to Madaripur and to Barisal, and from Dacca to Aricha. A systematic policy of road and railway construction in the eastern districts of Bengal would be a repetition of the mistakes, which have contributed in no small measure to the economic decline of Central and Western Bengal. More attention should be diverted to the policy of the improvement of waterways and inland navigation, the making of new waterways by means of cuts, where none exists at present, the easing of bad bends of rivers and the clearance of aquatic weeds in the waterways. The German policy of 'railways and waterways' rather than of 'railways *versus* waterways' is nowhere so indispensable as in Eastern Bengal, where the water-borne traffic is still one of the largest in the world.

¹ See also Bentley : Malaria and Agriculture, Appendix III.

Drainage and River Contrasts in Northern Bengal—A New Delta being piled up on the Old. In Northern Bengal the old rivers have been silting up their beds for some decades, and large areas, which were ancient seats of civilisation, are now water-logged, and fever is rife. Population is sparse towards the north, but is thickly distributed along the banks of the Jamuna, which is a new, active river, a course into which the main stream of the Brahmaputra found its way since 1787, deserting its old bed through Mymensingh. The region of high density along its banks is continued up the course of the Tista, cutting through the central portion of Northern Bengal, and leaving less densely peopled tracts with marshy depressions on either side. The railway embankment now runs across the natural slope ; obstructed drainage and recurrent floods being inevitable results, especially in the south-east of this region. The Baral river, the only instance of a distributary of the Ganges northwards, is silting up. The decline of this river as well as of the Atrai, the Karatoya, the Ichhamati and several smaller rivers has led to the dissemination of malaria. But for the sudden swerving of the Jamuna, on whose banks as the river cuts across Northern Bengal the lands are being formed and re-formed by heavy silt deposit as in the lower delta and support a thick population, this region on account of great interference of natural drainage by the railway embankment would have shown greater approximation to the decadent conditions in the south. Drainage has, indeed been entirely reversed due to the emergence of the Tista and the Jamuna, and the capture of ancient channels by their tributaries or their rivals in Northern Bengal. Thus there have been widespread obstruction of drainage and water-logging in the southern districts of Northern Bengal, which are seamed by a series of marshes and deserted beds of old rivers. The lower end of the Chalan bil—the marsh extending over about 140 square miles on the borders

of Rajshahi and Pabna districts—into which drainage used formerly to pass is, for instance, now being filled up with silt by the Baral and the Jamuna. These rivers are largely responsible for the decadence of the original drainage system. All the rivers, which flowed through the centre and east of these districts, have in fact now become moribund and are gradually silting up. These have raised their banks above the level of the surrounding country so that there is no natural drainage to the detriment of public health. The obstruction of natural drainage is also responsible for recurrent destructive floods, especially as these districts are full of basins, *bils*, and depressions ; while the rivers have decayed or have been beheaded. When there are vast accumulations of water in a year of heavy rainfall, the Atrai, the Karatoya, and other waterways cannot cope with the needs of drainage, though these carry off much flood water through the Chalan bil and the swamps of Pabna to the Brahmaputra. On the other hand, when the Brahmaputra and the Ganges are in high flood at the time, the flood water of the Padma coming in through the Baral and its channels is added to the Atrai waters and the high level of the Brahmaputra also retards the flow through these districts. Finally, the railway embankments contribute to prevent quick drainage. The main line of the Eastern Bengal Railway, which runs north and south through the district, cuts across the line of drainage, which is from west to east, and the recently opened line from Ishurdi to Serajganj crosses the waterways through which the excess waters of the district ultimately pass. The Collector of Rajshahi notes that the number of spans on the bridges of the Eastern Bengal Railway has been reduced since the broad gauge line was constructed. Between Atrai (mile 160) and Santahar (mile 173), the total existing waterway is reported to be 440 feet as compared with 967 when the line was first made. In the flood of 1918, about

1,200 square miles, that is nearly one-half of Rajshahi, was affected, the height of the flood varying from 2 to 4 feet above any previously known to the locality, and more than 70,000 houses collapsed or were badly damaged.¹ The destruction of houses, cattle and crops and dislocation of the agricultural routine and business for several months, caused by heavy floods in Northern Bengal, have raised problems which are different from those in the moribund delta. A new delta is being piled up on the old by the Tista and the Jamuna in Northern Bengal, and on one side river action and land building are in progress, while in another these have practically ceased within a short distance. The effects of differences of land and water levels arising out of natural forces have been aggravated by artificial conditions and agencies such as railways, embankments and human prosperity. As in the case of the moribund delta, economic prosperity here depends in large measure on the skill and foresight of the irrigation engineer.

¹ Nelson : Settlement Report of Rajshahi, 1922.

CHAPTER V

AGRICULTURAL DECADENCE AND MALARIA IN CENTRAL AND WESTERN BENGAL

Marsh and Mosquito in Two-fifths of Bengal. When we turn from the flourishing new and active delta to the old and moribund delta, we realise a sharp and sad contrast. Central and Western Bengal are portions of the Ganges delta, which have become inactive. Most parts of the delta have been raised above the level of periodical inundation by the silt deposits of the Ganges and its tributaries, which formerly distributed abundant red water derived from the main river. The fertility of the soil has declined owing to loss of inundation silt, when the rivers have deteriorated as the result of the Ganges having marched eastward. The deposition of silt is indispensable for the maintenance of fertility of the deltaic soil, constituted generally as it is of sandy loam. When the rivers have become moribund and failed to supply silt, agricultural yield has rapidly declined, causing considerable land to lie fallow and revert to jungle. Many rivers of Central and Western Bengal are now no more than channels of local drainage and are quite unfitted for this service, having been formed to carry much larger volume of water. Thus they maintain but a languid vitality during the monsoon season, and for the greater part of the year are merely chains of stagnant pools.¹ These gradually become choked with vegetation, that grows abundantly due to the sluggishness of the current, further impedes the flow,

¹ Thompson : Census Report of Bengal, 1921, pp. 58, 61.

and induces silt precipitation. Stagnant or sluggish waters, full of aquatic weeds, become breeding places of anopheles. Away from the dying or dead rivers, the old river-beds, *bils* and depressions, that no longer obtain the fertilising flood water that also carries fries of carps, voracious eaters of mosquito larvae, also become ideal breeding sites of mosquitoes. Upon the entire region representing about two-fifths of the total area of the province, which is deprived of the services of the rivers, the mosquito has descended and conquered, with the result that the decline of agriculture, spread of jungle and malaria, and desertion and enfeeblement of the population by recurrent attacks of the disease are found together in a nefarious combination, which easily defeats the agricultural officer, the economist and the sanitarian alike.

That degradation really began about two centuries ago, when the Ganges marched on its way to the Meghna, and the rivers of the region, which were active offshoots from the Ganges began to be reduced to a network of moribund channels. The interruption of the flow of the Bhagirathi, caused by the deterioration of the Damodar, the Ajay, Mayurakshi and other rivers as a result of land-raising and destruction of forests in the catchment basins of these rivers, aided the eastward sojourn of the Padma and the deterioration of the Nadia and Jessore rivers. The notorious Burdwan fever appeared in epidemic form in the first quarter of the last century in Jessore, the heart of the dead rivers area, and spread from place to place, sweeping over Western Bengal. Burdwan, Hooghly, Jessore and Nadia have never recovered since ; the malignant epidemic, which re-appeared subsequently and in severe form till the eighties of the last century, causing a mortality of several millions. There is no abatement of the fell disease, and the history of Central Bengal is a tragic chronicle of depression, disease and desertion. But malaria is not confined merely to Central and Western Bengal. It is now a scourge for about two-thirds

of the entire area of the Province, subject more or less to water-logging and obstruction of drainage, where economic decadence has set in.

The climate has become unhealthy, where the natural drainage has been disorganised, an indirect consequence of the degradation of former tributaries of the Ganges into stagnant lagoons, and the construction of numerous embankments and high roads along the natural drainage channels without sufficient culverts. The Laltakuri and Bhagwangola and other marginal embankments of the Bhagirathi and the Hooghly bridge as well as road-construction in Murshidabad and Nadia speeded up the decline of the Bhagirathi and of its tributaries in Western Bengal.

The railway lines were first constructed in Bengal between 1854-1856. These worked mischief in Western Bengal in the following manner. The railroad, which was built with an inadequate number of culverts, obstructed even the passage of monsoon water. On one side of the railway the embankment was made especially strong to avoid the least possible risk of a breach of the railway even by abnormal floods. Several other parallel embankments were created such as the high roads and the Eden canal. All these effectively shut out the flood waters of the Damodar, the Rupnarain, the Ajay and Mayurakshi and of other minor rivers which acted as spill channels for the distribution of the red water. The decline of the rivers in Western Bengal and decadence of agriculture in Burdwan and Hooghly were clearly discernible since the middle of the 19th century.

The Construction of Embankments. In Central Bengal, the construction of embankments of the Eastern Bengal Railway similarly contributed to the decline and ultimate death of the Jamuna, the Jelanghi and the Mathabhanga and of their spill channels. Many of the formerly active rivers, such as the Bhagirathi, the Bhairab, the Jelanghi, the

Mathabhanga, the Ichhamati and the Kapotakshi, are now gradually heightening their banks and beds, until the drainage is away from instead of towards them. The subsoil water, being unable to drain away rapidly, remains long at high level after the wet season, and prevents the soaking in of rain-water, resulting in casual collections of stagnant water remaining for long periods in every hollow, natural and artificial. Water-logged, miasmatic wastes have also expanded, and the increase of humidity has proved particularly favourable for certain characteristic moist weeds, which invade agricultural lands and shelter certain species of mosquitoes causing malignant fevers. Entomologists have found that the number of mosquitoes reaches the maximum after the rainy season in Bengal, and the minimum is reached in mid-winter. In each month the number of larvae depends not so much on the amount of rainfall as on the number of rainy days in that month.¹ Ponds, hollows and depressions with marginal vegetation are the chief breeding places of those species of mosquitoes, which are malaria-carriers. In the upland areas in some districts in Western Bengal, the geological formation also favours the retention of water in places where the surface is uneven, for the soil has an impermeable stratum, which prevents percolation.² The silting up of the Saraswati and the Bhagirathi, which commenced from the 17th century, the detour of the Damodar towards the west in 1770, the decline of the rivers of Nadia and Jessore since the beginning of the last century, and the interference of natural drainage by railway and river embankments,—all have conspired to bring about widespread

¹ *Vide* Fawcus: Final Report of the Khulna Settlement p. 46.

² A. C. Ganguli: Observations on Malaria-carrying Mosquitoes of Calcutta. Records of the Malaria Survey of India, September, 1935.

water-logging, malaria and agricultural decline ; and a large part of Burdwan, Hooghly, Nadia and Jessore districts is to-day characterised by decrease of cultivation and population and by overgrown vegetation, burying the homesteads of ancient but deserted village sites.

Population Decrease, the Index of River Decay. Comparing six districts in the moribund delta from west to east and north to south, we find that the districts, facing the sea, have higher density. These contain rivers that are less inactive and carry larger volumes of water, which periodically inundate the land.

Districts in the Moribund Delta

Burdwan	Nadia	Jessore
Density of Population per sq. mile		
583	531	576

Districts Facing the Sea

Hooghly	24-Parganas	Khulna ¹
Density of Population per sq. mile		
938	516	595

Compared with the rivers of Burdwan, Nadia and Jessore, the rivers of Hooghly, 24-Parganas and Khulna still carry large volumes of water, which periodically flush the land. They have not altogether lost their free spill, and discharge areas, and some, which are within tidal range, are yet active. The agency of river action in determining the movement of population is apparent. As we proceed eastward along the sea-face density increases, the land annually fertilised by the silt deposit of the eastern distributaries of

¹ Excluding the scarcely inhabited reserved forest.

the Ganges being able to support a far greater population than the western areas where there is little free river spill :

24-Parganas—541 ; Khulna—595 ;

Bakarganj—834 ; Noakhali—1,124.

In the districts of the upper delta the anabolism of delta-building is complete and katabolism has set in : the extent of the katabolism during the next few decades will be an interesting index of the rate at which population declines when the rivers die.¹

Shortly after the anabolism of delta-building was completed, malaria became serious in the districts of Murshidabad, Nadia and Jessore which are now regarded as the home of the disease in Bengal. We may fix the period of decay of the rivers of Central Bengal from the surveys of Major Rennell (1781) and Captain Colebrooke (1797), who found that these rivers were not passable by boats throughout the year. Malaria became a serious scourge since the beginning of the nineteenth century in Western Bengal, when Baranagar, the residence of Rani Bhavani on the Bhagirathi, north of the city of Murshidabad, was said to have been destroyed by an epidemic fever. In 1814, immediately following the change of course of the Cossimbazar river, an epidemic of fever again raged in Murshidabad, and depopulated the once flourishing city of Cossimbazar. It is now a jungle-ridden village, sleeping by the old forsaken bed of the Bhagirathi, which once encircled it, forming an island. In 1825 the first outbreak of fever is known to have taken place in Jessore, and in 1832, fever soon laid waste the large town of Muhammadpur and the prosperous village of Ula or Beernagar in the district of Nadia. Malaria then travelled across the decaying Bhagirathi into the Hooghly district in 1857-59, raged as a virulent epidemic in Burdwan

¹ Report of the Drainage Committee, Bengal, 1909.

('Burdwan fever'), Hooghly and Nadia districts between 1862 and 1874, and spread to the other districts of the Burdwan division as well at a later period, making a more or less permanent home in Central and Western Bengal. No doubt it takes some time for the deterioration of the rivers to exercise their full effects. After the deterioration of the river system is completed, the anopheles take possession of the land, and find in the innumerable low-lying pools and depressions; never properly drained or flushed out, in the silted beds of the once active rivers and *nalas*, and even in the hoof-marks of cattle, an ideal breeding place, and in the increase of humidity their optimum conditions of living. Deficient and obstructed drainage, rise in the subsoil water-level, growth of moist jungle and increase of humidity, which all come in the wake of decadence of the local river system, finally secure a most favourable soil for the destructive mission of malaria as an endemic disease.¹

High Sub-soil Water and its Effects. In some areas of Burdwan, and Murshidabad, the subsoil water-level has fallen, causing a deterioration of cultivation of the surface-rooted and wet variety of rice. The high land becomes too dry to be valuable, while there are wide marshes at low levels which do not drain and in which water lies all the year round. On the whole, however, the subsoil water-level has shown a tendency to rise throughout Central and Western Bengal. Generally speaking, it is the combination of these three factors, the silted-up rivers, channels and *khals*, the high subsoil water, and the jungly and moist conditions of the villages, which so seriously increase the

¹ For the history of fevers in Bengal, see Hunter: *Statistical Account of Bengal*, Vol. II, and O'Malley's Census Report of Bengal, 1911; *vide* also Pringle and Kemm: *Nadia Settlement Report*, pp. 10 and 232.

malaria rate.¹ A closed river, with its legacy of marshes, pools and depressions, choked with weeds, and the jungle, with its moist nooks and corners, which are inadequately exposed to sunshine, exhibit the optimum conditions for the breeding and multiplication of anopheles. When the rivers silt up and no longer flow freely, the district is at once changed for the worse and presently is blacklisted with the most malarious in the province.² Rajshahi, Murshidabad, Burdwan, Hooghly, Nadia, Jessore, part of the 24-Parganas and Faridpur have all suffered this degradation. Seventeen out of twenty-eight districts are now malarious in Bengal. At least 60,000 of the 86,618 villages in Bengal are more or less severely affected by the malady, which levies an annual toll of 350,000. In all the seventeen districts there are old watercourses which have silted up; the natural drainage of the country is disturbed, and large tracts are water-logged and full of jungle. In 1907 a large number of villages in Murshidabad, Nadia and Jessore were examined with the object of ascertaining the influence of situation on malaria. The average spleen rates of villages situated on live and dead rivers, in *bils* and on dry lands, are compared in the following table :—

	Number of villages examined	Average spleen rates
Live Rivers	33	46·0
Dead Rivers	38	64·5
<i>Bils</i>	56	62·2
Dry land	45	45·6

Villages, situated in *bil* lands and on dead rivers, have been shown to have a higher average spleen-rate than in other situations ; and this is owing to the fact that in these situations the natural drainage is imperfect on account of

¹ Note by Stewart and Proctor.

² *Ibid.*

the insufficient fall in the levels of the country, and consequently there are a high subsoil water-level, a low rate of fall in the subsoil after the rains, and water-logging. In Murshidabad the survey showed a definite connection between the spleen-rates and the rapidity of fall in the subsoil water-level, the villages with the greatest fall since the rains having the lowest average spleen-rates. The following represent the order of sub-divisions in Bengal, where the spleen indices are higher than 50 :—

Kalna	88
Ranaghat	75
Krishnagar	73
Bongaon	71
Meherpur	70
Burdwan	70
Pabna	65
Rajshahi	57
Chuadanga	57
Jhenida	57
Natore	53
Magura	51
Murshidabad	50

It is significant that the decline of agriculture and population are both associated with high spleen-rates. The freedom from malaria of the sub-divisions in Eastern Bengal will be evident from the following :—

Goaland	49
Faridpur	20
Sirajganj	18
Dacca	13
Gopalganj	8
Mymensingh	7
Madaripur	2
Munshiganj	1
Narainganj	1
Noakhali	1

Jungle, a Symptom of Decadence. In all malaria-stricken areas, the jungle is on the increase. In the first place, the jungle is a measure of the age of the village, the jungly villages being old villages with broken surface and foul soil. Secondly, on account of the prevalence of malaria, cultivated land is left fallow, homesteads are broken up, and the jungle invades the village site. On the other hand, the thick jungle delays the drying up of the soil and evaporation of surface collections of water in pits, hollows, and hoof-marks of the village cattle, and also protects the mosquitoes against sun and wind. Scrub jungle invades not only the arable land but also the homestead sites, each of which has its little pool from which earth for repairing the plinth of the houses is taken. Than these pools, filled in the rains with dead leaves, no more prolific breeding grounds for mosquitoes could be desired.¹ The effect of the amount of jungle present on the malaria of the villages in Nadia, Jessore and Murshidabad is shown below :—

Jungle and Malaria

Amount of jungle	Number of villages examined	Average spleen-rate
Thick	97	68·8
Moderate	47	48·1
Open	26	26·2

In the dense shade of the jungle, or in the uncared-for orchard, there are innumerable low-lying places, swamps, ponds, and the like, where anopheles thrives while the small weed-sheltered pools, burrow pits and ditches, in the village site, encompassed by prickly cane and bamboos,

¹ McPherson: Settlement Report of the Districts of Pabna and Bogra.

are peculiarly favourable to the larvae. Here and there in Burdwan, Hooghly, Nadia, Jessore or Pabna the dilapidated remains of big *pacca* houses, built in the middle of the last century, testify to the former prosperity.

The increase of jungle, invading streams, ponds, fields and homesteads alike, is thus symptomatic of the decline of agriculture, the decay of an old inhabited area and the prevalence of malaria. On the other hand, malaria decimates the rural population, leaves them weak and listless, and leads to wholesale emigration from the villages. The land is, therefore, allowed to lie fallow, or there is an increase of jungly growth, which in its turn fosters disease and the rural exodus.

The Red-water Famine. All these are, however, primarily due to the want of natural drainage in the country owing to its position in the moribund tract of the delta, where the active land-building function of the rivers has ceased. Where the rivers are no longer open, tidal and clean-banked as in the active delta, not merely is malaria a great scourge, but also there is soil exhaustion due to the lack of flush-irrigation, "the red-water famine." What the loss of inundation silt implies can be gauged from the result of some experiments in the area irrigated from the Eden canal system, which show that the plots receiving river water yield 25 maunds (2,057 lbs.) of paddy per acre, whereas they give only 16 maunds ($1,316\frac{1}{2}$ lbs.) per acre, when cultivated with rain-water. Again, in certain portions of Murshidabad, bordering on the new Gobra-nala cut, that had the benefit of flush-irrigation by silt-laden water, the yield of paddy per bigha increased from 3 to 4 maunds to about 5 to 6 maunds in 1933 and about 10 maunds in 1934. Figures from the Chinsura Agricultural Farm similarly show that lack of irrigation leads, on an average, to failure to transplant about 20 per cent. of the land, and with irrigation there is not only full transplantation but a greater

yield. The average figures of crop out-turns worked out for Chinsura are as follows :—

			Average yield of paddy (Maund per acre)
Without irrigation	...	...	15
With irrigation	...	...	28
With silt irrigation	...	...	35

The loss of yield is also shown by the following figures :—

				Average yield.	
				<i>Aman.</i>	<i>Aus.</i>
				(Maund per acre)	
Nadia	...	...	...	9·8	10·2
Jessore	...	...	...	14·0	10·6
24-Parganas	...	...	...	10·3	12·4

In these districts the yields of paddy might approximate the Chinsura figures with adequate irrigation ; while a considerable amount of land, now shown as old fallow, might be brought under cultivation with irrigation with the red-water. Crop-cutting experiments in the Damodar canal area indicate large increases of yield and expansions of transplanted area with irrigation. Crops irrigated with the rich red-water of the flood have a vigour and stamina, enabling them to withstand the early failure of the monsoon, which the anaemic crops deprived of the red-water cannot possess. Thus anaemic cereals and anaemic men and cattle go together.¹

Decline of Cultivation and its Causes. Along with the decline of yield we have in some districts of Central and Western Bengal an actual contraction of the area cultivated.

¹ Sir W. W. Wilcocks' article in the *Viswa Bharati Quarterly*.

In the districts in Eastern Bengal all available land is being taken up for cultivation, and a large portion of the cultivated area bears more than one crop ; the percentage of “ cultivated land,” which in any year bears no crop at all, also is very small, almost negligible. In Western Bengal, “cultivated land” often remains untilled, while the percentage of twice-cropped area is much less than in Eastern Bengal. The following table will show the situation :—

	Percentage of the cultivated area		Proportion of twice-cropped to net-cropped area
	Old Fallow	Current Fallow	
1. Birbhum	9	6	2
2. Bankura	9	2	1½
3. Nadia	8	9	3
4. Bakarganj	4½	1½	15
5. Dacca	1	½	35

On account of the decline of fertility, jungle growth and prevalence of malaria, the amount of good cultural land left fallow is quite large in some districts in Western Bengal. In Bankura the percentage of area shown as cultivable but not cultivated is 22 per cent. of the whole for the complete district, and 27 per cent. for the Sadar Sub-division. In the district of Jessore the total of new fallow area of the two sub-divisions of Magura and Jhenida now is found to be 18,260 acres as against only 7,640 acres, calculated by Babu Ramshanker Sen during 1872-73. The following comparative statement shows the change in the employment of land in two sub-divisions within fifty years :—

	MAGURA		JHENIDA	
	Percentage of area cultivable but not cultivated	Percentage of uncultivable area	Percentage of area cultivable but not cultivated	Percentage of uncultivable area
1872-73	2·54	2·74	2·43	3·03
1925	8·85	13·11	11·51	11·17

The percentage of cultivable and uncultivable waste lands, as then found, compared with the percentage now found, shows considerable increase in the uncultivated and uncultivable areas. The new fallow area in Jessore is more than four times that of Faridpur. In an interval of only ten years, 1921-1931, the percentage of cultivated to cultivable area declined in the moribund deltaic tract as follows :—

	1921.	1931.	Variation of density per Sq. mile.
Nadia	44·7	37·0	—4
Jessore	85·4	60·5	—17
Hooghly	62·3	51·2	—29
Burdwan	54·0	39·1	+51 *
Rajshahi	75·8	56·4	—21

Burdwan, which shows the largest shrinkage of cropped area, was described as an exceedingly healthy tract and the “ garden of Bengal ” at the time of the British conquest. Even in the beginning of the seventeenth century Burdwan was celebrated like Tanjore in the Cauvery valley for agricultural wealth. Buchanan Hamilton observed in 1815 : “ In productive agricultural value in population to its size in the whole of the Hindusthan, Burdwan claims first rank, and Tanjore second.” Only 39·1 per cent. of the cultivable area is being cropped here now, as compared with 54 per cent. in 1921 and more than 80 per cent. a few decades ago. De-population and physical breakdown, due to malaria and decline of soil fertility, have, indeed, led to a serious set-back of cultivation in Central and Western Bengal. In some of the more decadent areas land fit for

* This increase is to be mainly attributed to the immigration of labourers, which are attracted by the collieries and other industrial concerns.

cultivation often remains untilled, and tends to be covered with jungle, and there is more land than there are cultivators available. Local trade and commerce also languish as the rivers cease to flow freely, and there is all-round economic depression centred round the decrease of cultivation.

Aboriginal Labour, the mainstay of Agriculture. The large quantity of cultivable land, which is left fallow and is covered with jungle in Central and Western Bengal, attracts aboriginal settlers from Chota Nagpur, East Bihar and the Sonthal Parganas, while large numbers migrate from Central Bengal to Northern Bengal. From Nadia and Murshidabad, there is a very decided movement of population northwards across the Ganges to healthier and more protective areas in Malda and Rajshahi. About 41 thousand represented the balance of migration across the Ganges in 1921. There is also a constant stream of migration of the aboriginal races to Burdwan, Hooghly, Jessore and parts of Nadia, where, as concomitants of malaria and depopulation, land has gone out of cultivation. Thus the Munda, the Oraon, the Santal and the Bauri fill the gap left by the Bengalee peasant, who is fighting a losing battle with the moribund rivers, agricultural decay and disease.

	BURDWAN		HOOGHLY		NADIA		JESSORE	
	1921	1931	1921	1931	1921	1931	1921	1931
Immigrants per 10,000 of the total popula- tion ...	659	735	835	991	104	83	28	31
Aboriginal tribes per 10,000 of the total population ...	57	66	36	39	4	5	1	1

The figures do not exhibit the migration of the aboriginal clearly. A large number of peoples, originating in East Bihar and Chota Nagpur, such as the Bauris and the Bhumijes, have been introduced since the middle of the last century,

and many immigrants also are now returned as native-born although of course retaining their aboriginal race. The backbone of agriculture in large parts of Burdwan and Hooghly is now the immigrant aboriginal. But it is obvious that Sonthal agriculture is a much less skilled and intensive farming, and thus though fallow land is being taken up agricultural decline has not been checked at all.

Factors of Agricultural Prosperity and Colonisation in the East. In most parts of Eastern Bengal, on the other hand, the process of colonisation and settlement continues, and jungle areas and marsh lands form an outlet for the surplus population. Some areas, indeed, have grown so fast that the problem of finding sufficient land will soon become acute. The standard of living and of comfort here is much higher than anywhere else in the Ganges valley. The peasant is reasonably certain of harvesting a sufficient paddy crop. He has a source of ready money in jute as well as in the produce of betelnut and cocoanut plantations. He is more laborious and enterprising than his western compeer; he lives as much on water as on the land. Nature also looks after the region's sanitation, for every little creek in the active delta is flushed twice a day by the tide. The diet, based mainly on fish, which is much more abundant here than in most deltas of the world, is much more nutritive as well as certain. Above all, the population is predominantly Muhammadan. Polygamy among the Muhammadans, and widow re-marriage among both the Hindus and the Muhammadans as well as absence of economic pressure in new clearings account for the high rate of natural increase of numbers. Where life on the islands and accretions near the estuary is exposed to dangers from storm, waves and cyclones, new Muhammadan settlers live without fear and their families may thrive on account of polygamy. Thus do the Muhammadan and Namasudra peasants brave the cyclones of the

estuary and the wild beasts of the Sundarbans as they carve out holdings and gardens from mangrove swamps and jungles; while, not being rooted to the soil for generations or even for many years, they are more mobile than the peasantry of the more stable villages of the west. Thus an increase of economic pressure in Mymensingh or the shrinkage of the *aman* crop, due to water hyacinth and early floods, in this and other areas in Eastern Bengal have led to wholesale migration up the course of the Jamuna northwards and then north-eastwards into the Assam Valley as far up as Gauhati, and from thence more on the left bank of the Brahmaputra as far as Tezpur. Such an exodus of peasant families involving about 950,000 persons within the last three decades is unparalleled in the world in its push, magnitude and influence.

Relations between Agriculture, Malaria and Population Variation. The following table shows the contrasts of agriculture, health and movement of population between Central and Eastern Bengal during the last thirty years :—

Comparison of Agriculture, Health and Population Movement in the Moribund and Active Delta

I	II	III	IV	V	VI	VII
	Cropped area 1901-2	Normal cropped area at the end of the last century	Cropped area 1931-1932	Percentage varia- tion of cropped area	Incidence of malaria 1930 (Fever Index)	Percentage varia- tion of popula- tion 1901-31
<i>Districts in the moribund delta</i>						
1. Burdwan	1,128,300	1,248,300	742,100	-40	53.4	+ 3.7
2. Nadia	847,400	990,400	913,200	-7	56.5	- 8.1
3. Murshidabad	1,136,600	1,106,600	946,500	-14	41.7	+22.9
4. Jessore	1,270,500	1,303,600	887,300	-31	48.2	- 7.2
5. Hooghly	491,300	541,400	293,900	-45	46.6	+ 6.2
<i>Districts in the active delta</i>						
1. Dacca	656,080	1,086,169	1,709,000	+57	9.7	+28.9
2. Mymensingh	3,124,400	3,076,800	3,674,500	+19	11.0	+28.5
3. Faridpur	1,252,200	1,295,800	1,470,300	+13	26.6	+21.8
4. Bakarganj	1,686,000	1,660,000	2,015,000	+21	8.3	+27.1
5. Tippera	1,297,400	1,315,900	1,472,800	+11	7.2	+37.7
6. Noakhali	880,900	429,087	1,192,600	+152	10.5	+42.9

During the last two years remarkable decreases of cultivated area are shown by Burdwan, Nadia and Jessore and correspondingly remarkable increases by Dacca, Bakarganj, Tipperah and Noakhali in the active deltaic tract, as shown below :—

	Total cropped area (1933-34) in acres
Burdwan	711,200
Nadia	858,400
Jessore	810,000
Dacca	1,746,300
Bakarganj	2,057,100
Tipperah	1,416,400
Noakhali	1,266,900

Past Prosperity and Possibilities of Reconstruction. Some parts of Eastern Bengal, such as Bikrampur in the Dacca district or Muradnagar in Tipperah, are ancient centres of high density, dating ten and five centuries back respectively. This high density is still maintained. On the other hand, parts of Nadia, Burdwan, Jessore, Murshidabad and Rajshahi, which were centres of high density in Bengal, when the eastern tracts were wildernesses of forest and swamp, inhabited by wild buffaloes, rhinoceroses and tigers, constitute the most decadent region in the whole valley. Speaking of this region about 1670, Bowrey said : “ On the great river Ganges and many large and fair arms thereof are seated many fairy villages, delicate groves and fruitful lands, affording great plenty of sugars, cottons, lacca, honey, beeswax, butter, oils, rice, grain, with many other beneficial commodities, to satisfy this and many other kingdoms. Many ships of the Dutch, the English, the Portuguese do annually resort to lade and transport sundry commodities ; hence great commerce goes on into most parts of account in India, Persia, China and South Seas.” The

decay of the distributary river system from the Ganges, the fall of the subsoil water-level, the lack of overflow irrigation, and consequent loss of fertility and defective drainage, with their associated evils, have led to an economic decline so catastrophic that the above description can hardly be believed by a modern villager to apply to this region in the historic past. Again, Bernier wrote in 1660: "The knowledge I have acquired of Bengal in two visits inclines me to believe that it is richer than Egypt. It exports in abundance cottons and silks, rice, sugar and butter. It produces amply for its own consumption of wheat, vegetables, grains, fowls, ducks and geese. It has immense herds of pigs and flocks of sheep and goats. Fish of every kind it has in profusion. From Rajmahal to the sea is an endless number of canals, cut in by-gone ages from the Ganges by immense labour, for navigation and irrigation, while the Indian considers the Ganges water as the best in the world." This description of the maze of countless canals in Western Bengal is significant, since it indicates that it is the abandonment of the ancient system of canal and overflow irrigation in Central and Western Bengal, which has brought about their ruin. Sir William Willcocks, the irrigation expert of Egypt, who recently came to Bengal, indeed, is convinced that Central and Western Bengal was formerly intersected with artificial canals. Every canal which went southwards, whether they have become rivers like the Bhagirathi and the Garai, or remained canals like the off-takes from the Bhairab, the Jelanghi and the Mathabhanga, were originally lined out and dug parallel to one another. They are spread apart and placed just where the canals should be placed. Formerly these canals were straight, but their winding courses now are the true gauge of the friability of the soil they traverse.¹

¹ Willcocks: *Ancient System of Irrigation in Bengal*, Calcutta University Readership Lectures, 1932.

He has suggested a scheme of flood-irrigation of Central Bengal, with an eventual Egyptian barrage of the Ganges at a point 14 miles below the Baral head. This barrage will not only irrigate the whole of Central Bengal by means of the rivers, Jelanghi and Mathabhanga, and their numerous branches, with a syphon under the Garai for Faridpur, but will also ensure a steady supply of water all the year round in the Bhagirathi and the Hooghly. By protecting the banks of the rivers, pumps may be put up providing perennial irrigation to a distance of 20 miles from the rivers. Modern pumps are very economical and effective. The water stored in pools, tanks and depressions could be made in this way a valuable asset to the country. Sir John Anderson, Governor of Bengal, also recently remarked that the only really satisfactory method of ensuring a perennial supply in the Bhagirathi river would be by taking control of the parent channel (the Ganges river) by means of a barrage, whereby the water level in that river can be raised to any required level after which the required flow can be diverted down its distributaries. "This, however," he said, "would be an enormous undertaking which cannot be considered at the present time for financial reasons."

Flood Flushing and Scour under Control. Less ambitious projects for flush irrigation are to relieve the congestion and utilise the spill from active rivers for flushing areas, which now depend only on local rainfall, and to introduce silt-laden water or divert the drainage of the swamps into dead rivers. In Northern Bengal the waters, which now run to waste, could be beneficially used either directly or by works designed to store them at times of flood for utilisation during periods of scarcity.¹ Thus the Ganges water in the flood season could be led into the Baral river, which could be revived as the waters of the Tista might be dammed by a

¹ Report of Irrigation Department Committee.

barrage near the hills and drawn off into a canal striking south-west across the head waters of the Atrai, the Karatoya and the Punarbhava, which could be flushed and resuscitated in a similar manner. The Baral is fast developing, and its improvement through bringing the flood water from the Ganges might, as the railway authorities fear, endanger the safety of the Hardinge Bridge. No such difficulty will be encountered in the case of the resuscitation of the Atrai, the Karatoya and the Punarbhava, which used to be fed formerly by the Tista, and where the levels also may probably be suitable for flush irrigation. North Western Bengal, large parts of which are full of meres and pools, will also benefit by irrigation and flood-flushing in certain areas from the Mahananda. Similarly, the Damodar water in high flood might, after clearing the weed-grown channels of the Saraswati, the Banka and the Behula, be directed into these for irrigation and drainage of a most decadent tract. Several flow irrigation schemes have already been adopted in Western Bengal. Thus the river Damodar is utilised in Burdwan district, the Cossye in Midnapur district, and the Bakreswar in Birbhum district, for irrigating about 180,000 acres, 80,000 acres and 10,000 acres, respectively. It appears, however, that though these rivers bring devastating floods by breaching the marginal embankments, it is not possible to extend irrigation by these any further without storage schemes. Limited flushing can no doubt be introduced by the provision of regulated escapes, built on the marginal embankments in the area lying between the Cossye, the Selye and the Rupnarain rivers in Midnapur district, and that lying between the Damodar, the Banka and the Hooghly, rivers in Burdwan, Hooghly and Howrah districts. The heads of the Jelanghi and the Mathabhanga might be dredged, where these take off from the Ganges and rivetted by way of protection against erosion, and increased quantities of water from the Ganges might be drawn, after building weirs, and diverted

through cuts or high-level canals, leading into the Bhairab, the Kumar, the Nabaganga, the Chitra, the Kobadak, the Kadla, the Belna and the Ichhamati. In the lower reaches of several of these rivers the water might be headed up again by weirs, and spread over the land. The levels south of the Mathabhanga are such that the entire area between the Mathabhanga and the Madhumati could be flushed by gravity by cuts and canals. On the Madhumati also there could be a weir, and this would allow a large stretch of country on either bank to be well irrigated.¹

The re-opening of rivers at their heads which from natural causes have closed, systematic deepening and widening of channels by dredging, easing of bad bends, the clearance and excavation of dead watercourses and minor channels, flood-flushing under control through the construction of weirs, cuts, high-level canals and sluices in embankments, and re-afforestation in the catchment areas of the rivers from which violent floods descend,—all these are indispensable for improving irrigation and drainage in Bengal, and reviving her dead rivers. Such projects should be financed by an improvement levy, according to the provisions of the Bengal Development Act, or by raising a provincial Development Loan.

Siltation and Drainage of Swamps and Low Lands. In most tracts of Bengal, which are decadent, the courses of the dead rivers are such that if water could be brought into them from the active rivers it can be distributed without difficulty over the area; there is a net-work of spill channels, and the problem is to fill these and keep them clear of

¹ Several such schemes are under consideration by the Bengal Government, *vide* Townend's pamphlet on the Development of Decadent areas in Bengal, March, 1935, and S. C. Majumdar's articles on Irrigation Problems in Bengal, *Science and Culture*, October, 1935

obstructions for flushing and scour. An active river may also be utilised for passing water into swamps and reclaiming these by silt, where such swamps are not indispensable for the life of minor rivers. In certain areas in Burdwan, Hooghly, Midnapur and Khulna, where water-logging has become a serious evil, it may be necessary to instal powerful, low lift pumps, as has been done in Egypt in connection with the Northern Nile Drainage Scheme. The partial failure of the Hijli Drainage Project for draining about 530 square miles in Contai, Midnapore district, has been an eye-opener. The scheme was intended not only to deal with flood water, but also to remedy water-logging. But in Bengal drainage alone apparently tends to increase malaria, and the fertility of the area has much diminished since it was reclaimed. It seems essential, therefore, to arrange not only for drainage but also for bringing silt water on to the land through sluices, which must be constructed in the embankments, and a very much larger area is in need of silt than is covered by the Hijli Drainage Project.¹

The benefits arising from drainage methods, such as the Italian *Bonificazione* for the enrichment of the soil and banishment of malaria, justify schemes according to which every dead or dying watercourse in the moribund tracts in Bengal may be allotted its quota of supplies, according to its requirements from a drainage circle for the purpose of flush irrigation. The Hijli Drainage Scheme in Midnapore and the Magra Hat Drainage Scheme in the 24-Parganas have already shown the possibilities of such works for the improvement of health and economic prosperity.

Bonification and Intensive Cultivation. The importance of land reclamation and drainage schemes and the resultant intensive cultivation and increase of wealth in the fight

¹ Report of the Irrigation Department, Bengal, 1933.

against malaria have been well described in a recent publication of the League of Nations: "The Netherlands is the country where the people as a whole have benefited most from land reclamation, but among the countries of Central and Eastern Europe, Italy is in the forefront as an exponent of schemes and systems of *Bonification* as an anti-malarial and general sanitary measure. On a smaller scale, Palestine has recently provided some excellent examples of the benefits, which have followed the general scheme of 'Bonification,' which is gradually being applied as far as possible throughout the country."¹ An increase of prosperity and general rise in the standard of housing and living, resulting from land reclamation, appear indirectly to reduce malaria incidence and severity even though large "Bonifications" may actually increase the abundance of anopheles in the area reclaimed. Malaria experts in different parts of the tropics, indeed, are now of opinion that an indirect attack through land reclamation and improvement of the standards of farming, housing and dietary has better results, as regards reduction of the incidence of malaria, than direct campaigns of mass quininisation and destruction of anopheles.

Co-operation of the Irrigation Department, District Boards, and Union Panchayats Recently the local bodies of Bengal have taken up the improvement of local waterways seriously. Several Union Panchayats have undertaken successfully anti-malarial measures and clearance of jungles and choked-up river-beds in co-operation. The co-ordination of the activities of the Public Health and Irrigation Departments and the Anti-Malarial Societies in the district of Burdwan and Nadia has also been fruitful in the fight against the jungle, morass and mosquito. The

¹ Second General Report, Malaria Commission, League of Nations.

Nadia District Board in conjunction with the Jessore District Board and the Irrigation Department has carried out schemes, which by bringing the flood water of the Mathabhanga into the Nabaganga and the Kobadak has been successful in flushing out water-hyacinth, and accumulation of decades and improving the agricultural and sanitary conditions over a large area in the district of Nadia and Jessore. This has been effected by means of small cuts, the Guznavi and the Bijay cuts, respectively. The Irrigation Department has offered its technical services in this connection, and also has prepared another scheme in Central Bengal for being taken up at once for flushing the deteriorating head reaches of the Kumar. In Nadia, again, the deterioration of the Bhairab is sought to be checked by means of a cut from Utampur about $1\frac{1}{2}$ mile below Jamsheerpur and the reduction of the length of the river from 82 miles to 60 miles up to its outfall in Mathabhanga at Subalpur. The scheme in which the local bodies have also participated aims at supply of good water and the removal of aquatic weeds from the river and improvement of water traffic. Due to its high natural banks it is not possible to provide for any irrigation and flushing of the area alongside it. In Murshidabad district the Gobra-nala, which became choked with water hyacinth, has been resuscitated by means of a cut connecting it with the river Kalkali, which takes off from the Ganges at Lalgolaghat. The nala is now cleared of weeds, and it has also been possible to irrigate a large area on either side of it by means of silt-laden water, and also to flush the ditches and uncultivated lands. Malaria has been driven out from several villages, which were so long hot-beds of the disease, a new village has sprung up on its banks, and the fertility of the entire area has been improved through the deposition of a thick layer of fine silt, and extermination of white ants as a result of flush irrigation. The Gobra-nala and the Bhairab cuts

have been effected at a cost of only about Rs. $3\frac{1}{4}$ lakhs and Rs. $1\frac{1}{2}$ lakhs, respectively. Among the remarkable efforts towards the excavation and clearance of silted-up, local waterways by the Union Boards, enlisting the voluntary co-operation of villagers, mention should be made of the resuscitation of the Kuralia *khal* in Brahmanbaria, and the Barasia in Jessore—Faridpur. In the former project ten to twenty thousand villagers engaged themselves daily in earth-digging, aided by the rich and respectable men of the locality.

Flood Prevention and Hydro-electric Development in the Hills. The Irrigation Department have recently instituted investigation to ascertain the possibilities of utilising the supply of the Bansloi and Mayurakshi rivers, and other hill streams for irrigation in the Rarh tracts of Murshidabad and Birbhum. The lack of an adequate system of irrigation is now becoming more and more noticeable in years of deficient rainfall, when the crops, particularly of the Rarh tracts, completely fail. Storage reservoirs in the hill or plateau, where there are head-water accumulations, may also be successfully adopted in cases of such rivers as the Damodar and the Dwarakeswar, the Suvarnarekha, the Ajay and the Mayurakshi for the augmentation of the flow in the dry seasons and prevention of spasmodic floods in the rains. Recently two suitable sites for storage dams for irrigation and flushing in Western Bengal have been discovered, *viz.*, across the river Mayurakshi at Mossanjore in the Santhal Parganas, where the river descends from the Dumka plateau into the plain, and the other across the Dwarakeswar at Suknivasa in Bankura district. Careful investigation will reveal appropriate sites for storage dams across the upper valleys of several other rivers, especially the Subarnarekha, the Damodar, the Ajay and the Bansloi. Majumdar points out the special advantages of storage schemes in Bengal as compared with Southern India, for instance, where

remarkably big storage dams have been recently constructed. In the latter region water has to be stored in winter months for utilization during the next transplantation season, *i.e.*, in July and August, when rain usually fails. Not only is there considerable loss due to absorption and evaporation during dry months, but the stored water has to be supplied at a time when the requirement of crops is the minimum. In Bengal, on the other hand, the stored water will have to be utilized within a short time after impounding; this involves very little loss of water, and as the requirement of crops in September and October is the minimum a very high storage duty can be realized. It is estimated that while in the Madras Presidency 1 million cubic feet of stored water can irrigate over only 5 acres, it can irrigate over 30 in Bengal. The peculiar advantage of irrigation of impounded water in Bengal, the possibility of cane expansion in several districts, the disuse of old tanks and the risks to agriculture in Western Bengal due to the precarious distribution of rainfall,—all justify schemes of irrigation on a large scale from the rivers, which have their sources in the Chota Nagpur and Santhal Pargana hills, and which now bring recurrent devastating floods. Incidentally it would be possible to arrange for the generation of hydro-electric power from the reservoirs, if there were a sufficient demand for it. In the United Provinces great economic possibilities recently have been opened up by hydro-electric development, which provides power not only for village industries but also for pumping water from rivers and low-level canals as well as from tube wells. In Bengal it might be possible to pump silt water by cheap electric power from rivers, which could not be used for feeding gravity canals. In the United Provinces four river-pumping stations have been established on the Ramganga, the Ganges and the Kali Nadi, which pump by electricity 400 cusecs of water into canals. The use of electricity for pumping

silt-laden water into dead rivers and watercourses might present certain advantages in areas where any interference with river-channels is to be avoided.¹ The association of hydro-electric works with the Tista Barrage Scheme may open up as much possibilities of economic development in Northern Bengal as the hydro-electric plants have done for the United Provinces ; besides, the devastating floods of the Tista could only be prevented and the dying rivers of the tract renewed and economic prosperity revived by such carefully planned and co-ordinated schemes of afforestation, irrigation, flood prevention and hydro-electric development.

Leguminous Fodder-cropping and Pisciculture. No doubt the restoration of basin and flood irrigation in the moribund tract of the delta, by whatever means it may be devised, will restore to the tract the rich red-water of the Ganges and the leguminous fodder crops, which will replenish the soil, and combat fevers. It is well known that wherever clover grows in Egypt, in the Argentine, as in certain reclaimed areas in Holland, there is immunity from malaria, in spite of plentiful colonies of the anopheles mosquito. Certain clovers, vetches and beans may be grown as readily in the Ganges delta as in the Nile delta, and these would not only feed the cattle but also would insure the country against malaria. Cultivated Egypt is mainly immune from malaria, and cultivated Egypt means Egypt with all its wealth of clovers, leguminous plants, melilotus, and trigonella.² Besides, systematic flush irrigation by replenishing the streams, swamps and village ponds and enriching the soil would not only combat malaria, but would also provide an abundant harvest of fish, check the present shrinkage of cropped area and yield, and make

¹ Vide Townend's pamphlet.

² For Sir W. W. Willcocks' scheme, see the *Viswa-Bharati Quarterly*, 1928, and also the *Literary Digest*.

congestion of the rivers impossible.¹ In Bengal there are many varieties of larvicidal fish, indigenous to the country, which are excellent surface-feeders and either breed in confined ponds and tanks or migrate for breeding purposes to all large swamps and inundated rice-fields, drains and ditches in the countryside. Flood-water, even where fed by large collections of rain-water from marshes, pools and tanks, will prevent the breeding and multiplication of mosquitoes, due to the presence of silt and of myriads of larvicidal fishes, whose spawning season coincides with the flood season in Bengal.¹

Discharge of the Major Rivers available for Flush Irrigation. The amount of flood-water discharge of the chief rivers of Central and Western Bengal, which may be available for flush irrigation is given in the following table² :—

*Average discharge of the rivers in Central and
Western Bengal*

River		Amount of average discharge (cusecs)
The Bhagirathi	...	50,000
The Jelanghi	...	40,000
The Mathabhanga	...	28,000
The Gorai	...	100,000
The Damodar	...	650,000
The Rupnarain	...	350,000

¹ For the relationship between Malaria and Irrigation, see Bentley: *Malaria and Agriculture in Bengal* and Haslam: *Schistosomiasis and Malaria in relation to Irrigation*.

² Vide G. C. Chatterjee's article on Overflow irrigation in Bengal. *The Modern Review*, May, 1935.

The Padma's flood-water discharge is 2,500,000 cusecs and rises to as much as 3,500,000 cusecs in an extraordinary flood season. Engineers point out that even if three times the amount now passing through the distributaries in Central Bengal be passed, there will be no catastrophic flood in this area, as there is ample section in the river for the water to pass away. On the other hand, the use of as many distributaries as possible for bringing in flood-water as well from all surrounding depressions and draining it away through as many branches as possible to the tidal creeks, will not only check agricultural decadence in Central Bengal, but will also relieve the congestion in the Padma and the Meghna, as is evident from the erosive action of these rivers.

The Experience of the Irrigation Department. "It may be the case," observes the Irrigation Department Committee, Bengal (1930), "that deterioration has already proceeded so far that it cannot now be checked, and that the tract in question (Central Bengal) is doomed to revert gradually to swamp and jungle." But they were strongly of the opinion that before so gloomy a view is taken a thorough investigation should be made of the possibility of a remedy. Although they take exceptions to some of Sir William Willcocks' frank criticisms, they agree to his suggestion that the only solution will be found to lie in flushing the dead rivers and, so far as may be possible, the country on their banks with silt-laden water from the Ganges and its effluents during the monsoon. They did not agree with the findings of the Drainage Committee of the Presidency Division (1907) that it would be inexpedient to attempt such action. The Irrigation Committee further observe that such a course, preceded of course by a complete hydraulic and topographic survey of the region, is eminently practical. "It does not appear that there are any greater natural obstacles in the way of such a course than those, which have to be overcome in

keeping open the inundation canals from the Indus, a deltaic river comparable in size to the Ganges and unlike it in some general characteristics, such as its tendency to wander throughout a wide trough." With the restoration of dead or dying rivers, the opening up of new channels to ensure a flow of head-water and the reclamation of the water-logged areas is implicated the future of Bengal.

The extension of tidal range in the lower delta must also be in the fore-front of a deltaic economic reconstruction scheme. For with this are involved the protection of the semi-fresh-water tidal rivers, comprising the central reaches of the fresh-water discharging streams as well as of those tidal rivers which discharge local drainage, and the improvement of navigation and sanitation. Their protection would include the prohibition of marginal embankments, and the plantation of a chain of forests on the sea-face, which may increase the natural spill-area, thus giving a new life to the moribund rivers and serve as a buffer protecting the riverine villages against cyclones and storm-waves. All this may retard agricultural expansion and endanger vested interests, but should be considered indispensable in the larger and more permanent interests of a decadent region. Similarly, the present policy as regards the extension of roads, railways and other similar works, which tend to check the natural movement of rivers and restrict flush irrigation and tidal action will have to be viewed afresh from an expert standpoint. Since 1895 the Irrigation Department by extending the Canals Act to all the chief rivers has set its face against the system of embankments ; but it is doubtful whether the new policy has not been adopted too late ; for the rivers touching some of the embanked area no longer carry enough silt to fill up the saucers, even if the embankments were removed.¹

¹ Fawcus : Khulna Settlement Report, pp. 33-35.

Lessons from the Dutch Experience. All this once again illustrates the lack of broad vision of the irrigation authorities. It must be recognised, on the one hand, that the population pressure in Bengal must lead to an extension of the frontiers of cultivation and continuous shift of the Sundarbans southwards. On the other hand, the reclamation must not be permitted to continue in a haphazard, irresponsible manner by tenants and zamindars so that the already too inadequate jungle areas and swamps between the Hooghly and the Haringhata may not be encroached upon; nor the land cultivated before it has been actually fitted for tillage either by the action of natural forces or by planned engineering. Much may be learnt from the Dutch plans for the damming and drainage of the Zuyder Zee, undertaken at a cost of about one billion florins and calculated to add 600,000 acres of the best soil or one-tenth of Holland's present area of agricultural land. The raising of dykes, which will mitigate the intensity of storm-waves from the Bay of Bengal, the plantation of defensive vegetation against the attack of sand dunes, the enlargement of swamps or basins into which the rivers may empty, and the construction of ditches, ring-canals and sluice-gates for the passage of water, would represent some of the features which may be adopted in a plan of land reconstruction in the tidal areas of Bengal. Many difficulties, which for centuries have stood in the way of proper drainage of large districts, will thus be solved, especially as in times of heavy rainfall there will be nothing against letting the water run away. The swamps will soon lose their saltiness when shut off from the sea and receive large quantities of fresh water from the fresh water tidal rivers; while in years of drought the swamps can be kept at a higher level and the country around can draw it off to irrigate the land. In Holland large fens and marshy tracts have been thus reclaimed by being drained into ditches and

canals, and by impoldering and endyking. In fact “no country has conquered so much land from the water, and hardly anywhere the struggle against the water so as to keep the land requires so much sacrifice.” The chief agency for this purpose is a host of water-boards existing for centuries in different parts of the country and undertaking the tasks of the removal of water, the upkeep of weirs and dykes, of drainage canals and of pumping engines. A Government Commission also has now taken in hand the improvement of the drainage of land in the higher levels. Besides, there is the Netherlands Moor Society (founded in 1889), which aims at reclaiming waste land, the upkeep of forests and plantations, the carrying out and upkeep of irrigation works, the improvement of land and development of fisheries. During the last twenty-five years private persons too have reclaimed large surfaces of waste land. The application of co-operation in the dairy industry has also largely contributed towards the extension of the stock of cattle on the sandy lands, causing a considerable tract to be reclaimed for pasturage. In the extreme south of the deltaic districts of Bengal between the mangrove forests and the sea lie extensive stretches of open grass lands with rows of sand dunes. These areas may be utilised as grazing grounds like those of Holland and the pre-sale of Normandy. Finally, to quote a Government report on the subject, “the development of the river, estuarine and marine fisheries of the Sunderbans from their present crude state by utilisation of modern methods of capture, storage and conveyance is a commercial enterprise, which promises greater prospects of success than the Eldorados of Port Canning and Frazergunge.”

Planned Engineering and Reclamation. From the extensive sea-face of Bengal, swamps, wide inlets of the sea, which have become silted up, lowlands where the water cannot run off sufficiently, reclaimed areas which are subject to cyclonic storms and storm-waves, vast stretches of grassy dunes,

which are inaccessible and suffer from scarcity of potable water, miasmatic jungles which no longer serve as natural spill-areas of rivers—all these must be recovered for agriculture by scientifically planned reclamation and engineering works in order that as parts of the Sundarbans become naturally raised above tide level the outward thrust of population of the province may not, by haphazard colonisation and dam-building, lead to the obstruction of drainage, water-logging, premature silting up of the tidal rivers and the sudden ruin of cultivation by the impenetration of saline water when embankments are broken. At present the colonisation of the Sundarbans means a fight against malaria and brackish water. This should not be the case if drainage and reclamation are planned even as skilful engineering might have avoided the premature physiographical senility and agricultural decadence of the upper delta. For both the upper delta, where the land-building action of the rivers has been completed, and the lower delta, where land-building is forced apace by the embankments, that sometimes effectively check the entry of saline water but now and then bow themselves before storm or tide to the ruin of fields and homesteads, it is the genius of the engineer which will determine the future health and movement of population. The restoration of the Ganges spill in Central Bengal will flush and scour the numerous tidal channels and improve their efficiency by transporting back to the sea the silt now being deposited in their beds by the tides, thus preventing deterioration both in the upper and the tidal portions of Central Bengal. Mere tidal flow, unless reinforced by a copious supply of sweet water, cannot maintain the tidal channels for an indefinite period. For tides in these parts carry a large proportion of silt with which nature is trying to raise the delta now deserted by the Ganges floods. An abundant supply of upland water through a diversion into these rivers of the

Ganges flood discharge can alone help not only to maintain the tidal reaches of these channels permanently, and in fit condition for navigation, but also to push down the salt-water limit and extend cultivation more and more towards the sea-face even without embankments as is the practice in Eastern Bengal.¹ Sound engineering, sound agriculture and sound sanitation have a common goal. In two-thirds of Bengal, neglected sanitation goes hand in hand with unsound or unsuitable irrigation and decadent agriculture. A century and a half of human mismanagement have caused to Central and Western Bengal the loss of their far-famed health and riches, but the situation is not beyond recovery by systematic economic planning.

Hydraulic Research. All schemes of irrigation, swamp reclamation and river management must be planned intelligently and with foresight, and for such projects not only field observations but also experiments in hydraulic laboratories are considered indispensable in Germany, Holland and the United States, which now lead the world in river-training works. The hydraulic laboratories of Karlsruhe and Charlottenburg, where model experiments for the control and regulation of tidal conditions in harbours or the reclamation of land from the sea are being carried on before Governments and river commissions and boards launch their costly schemes, might be commissioned with the tasks of solving problems of river management in Bengal or, far better still, a river training laboratory could be established in Bengal itself to carry on systematic hydraulic researches on models, supplementing the work of surveying and levelling, which the Irrigation Department now undertakes. Bengal has suffered so long from unplanned or mis-planned road and railway construction,

¹ S. C. Majumdar : Irrigation Problems in Bengal, *Science and Culture*, Oct., 1935.

cutting across the natural lines of drainage, dredging, *bandalling*, and construction of bridges and embankments, that it is essential that every big project must henceforth satisfy a searching test in the hydraulic laboratory before it should be considered by the legislature. Above all, it is only a Ganges River Commission, acting on behalf of the federal government, which can co-ordinate the divergent interests of the United Provinces, Bihar, Assam and Bengal as regards schemes of canalisation and river control ; the recognition that the Ganges and her tributaries form an integral system and that no project of irrigation, flood prevention or afforestation should be considered provincially, is overdue. What the Mississippi is for the different states in America, and the Rhine for France, Germany and the Netherlands collectively, the Ganges is for the United Provinces, Bihar and Bengal ; and river physics demands that the up-river and down-river areas should no longer pursue schemes in piecemeal and independent fashion, jeopardising the interests of each other.

CHAPTER VI

THE EASTWARD MARCH

Topography of Bengal. The great rivers have built both the land form and the prosperity of Bengal. Bengal, which is somewhat smaller than Great Britain, contains nearly a million inhabitants more than the British Isles. The whole of Bengal is a fertile alluvial plain, but this can be divided into four natural regions, according to the extent to which the soil is enriched by silt deposited when the rivers are in flood. These regions are : (1) the Old Delta, or (a) West Bengal, (b) Central Bengal ; (2) the New Delta, or East Bengal ; and (3) the Ganges-Brahmaputra Doab, or North Bengal. We are following closely O'Malley's descriptions of the characteristic physical features of each natural region.¹

West Bengal contains a portion, which is a rolling lateritic tract that runs through the western portions of Midnapur, Bankura, Burdwan, and Birbhum, and farther it includes the eastern fringe of the Chota Nagpur plateau. This tract is still largely covered by *sal* forests. The more important portion is a semi-aquatic rice plain, which is intersected by rivers, many of which are now silted up, while the beds of others are being gradually raised by the annual deposition of silt. Water-logged areas and depressions are here met with, and overgrown vegetation buries homesteads even in areas where a heavy population presses on the land. Central Bengal, which is bounded on the

¹ Census Report of Bengal, 1911.

West by the Bhagirathi, on the north by the Padma, and on the east by the Madhumati, is a portion of the Ganges delta, which has been gradually raised above flood level and has become moribund. The silting up of the rivers, which were active distributaries of the Ganges a century and a half ago, has deprived the country of the fertilising silt it formerly received. The sub-soil water level has also fallen. Consequently this region has declined in agricultural prosperity ; while the dead channels, as well as numerous depressions, *jhils*, and lakes, some of which are choked with vegetation, have made fevers endemic.

North Bengal extends from north to south between the lower spurs of the Himalayas and the Ganges. In the north there is an unhealthy submontane tract, the Terai, from which the country gradually slopes southwards in a wide alluvial plain, watered by the rivers flowing southwards from the Himalayas and broken only by the Barind. This is a comparatively high belt of laterite formation, an outcrop of the " old alluvium " lying on the confines of Dinajpur, Maldah, Rajshahi and Bogra, which grows only one crop, late rice, and which in consequence is subjected to scarcity in years of deficient rainfall, and supports a comparatively low density of population. The population has concentrated along the banks of the Jamuna, which forms the eastern boundary of this natural region. The Jamuna is a new river, a channel which has carried the main stream of the Brahmaputra since the early days of the 19th century, when it deserted its old bed through Mymensingh. Thomson observes: " The change was by no means catastrophic, nor is it an isolated instance of such a change within the same period ; for, since Major Rennel's survey of the rivers of Bengal between 1764 and 1775, the main stream of the Ganges has deserted its old independent course, through Faridpur and Bakarganj to the

sea, and joined the Meghna, 70 miles inland. Because the Jamuna is a new active river, the lands washed by it rather take the character of the land in the lower Delta and the population on its banks approaches in density that of the Eastern Bengal districts."

Most of East Bengal is a semi-aquatic deltaic plain, composed of the lower portion of the deltas of the Ganges and Brahmaputra. These great rivers overflow their banks during the rains and spread fertilising silt over the whole region, which remains for the better part of the year under water. There are marshes and depressions everywhere which are partially dry and covered with rice in winter, but are under water in the rains, when they form an almost unbroken fresh-water sea. The most important of such depressions in Bengal is of course the Chalan *bil* in Rajshahi district, which has a water area varying from 20 sq. miles in the dry season to 150 sq. miles in the rains. The Chalan *bil* is considered as the site of an ancient confluence of the Ganges and the Brahmaputra. The Arial and Kiranjir *bils* in Dacca, the Dhol Samudra and the Madaripur *bil* in Faridpur, the Boyra and Pabla *bils* in Khulna and the Jhanjhanian, Sarupkati and Rampur Chechari *bils* in Bakarganj may be mentioned. In Bakarganj small *bils* are common all over the district, there being one in almost every large village. The network of *bils* and depressions forms the natural storage basins of the rivers and plays an indispensable part in the free river spill and drainage of the entire deltaic region. During the last half a century, this, however, has been often lost sight of in the outward expansion of agriculture and population in Bengal, leading to unplanned colonisation and construction of dams, embankments and roads. An Executive Engineer, Mr. Man Singh (Nadia Rivers Division), has recently observed : " Construction of the network of roads and railways, often with insufficient waterways, besides having the direct

effect of causing obstruction to the free flow of rivers, has, on account of very often injudicious selection of alignments, interfered with the surface drainage and resulted in creation of water-logged areas, indirectly contributing to the deterioration of rivers, especially in Central Bengal.”

Effects of Embankments on Cultivation and Drainage. Most of the cultivated land in an active delta borders on the rivers. This land is a little higher, and therefore better drained, than the land back from the rivers. These strips of slightly higher land seem to have been formed by the same process by which the entire region was built up, viz., by deposition from flood waters. At times of high water most of the sediment is deposited close to the lines which mark the stream banks at ordinary stages of the river. This results in the accumulation through the centuries of somewhat thicker deposits near the stream than back of them. These strips of slightly higher land are called “natural levees.” As in the lower Mississippi country we have not only these natural levees in the Bengal delta, but also artificial levees constructed to guard against overflow at high stages of the river.¹ Calcutta has her wharves, warehouses and railway tracks, while Berhampur, Dacca and Noakhali, for instance, have also their artificial levees built along the crests of the natural levees. Such artificial levees and the failure to clear up the river-mouth and maintain easy flow during the summer months greatly facilitate the deposition of silt on the river beds, and in flood years the flood waters are not carried by the Ganges and the Padma evenly to the Bay of Bengal. At some places the rivers are in high flood but at other places the rise of the flood level is not abnormal. For instance, in September, 1934, though the Padma nearly reached the highest recorded flood level, and showed no sign of abatement of

¹ Jones and Whittlesay : *Economic Geography*.

her fury at Rajshahi, the flood was subsiding near Pabna, and in Vikrampur. As regards the Ganges, Nadia was not as badly affected as Murshidabad.¹ Besides these artificial levees constructed for the safety of many of the deltaic towns and large villages in Bengal there are also built throughout the tidal area marginal embankments for the purpose of land reclamation along the side of rivers and *khals*. The construction of these marginal embankments in the tidal areas has brought with it a train of evils: (1) Water has been confined to the rivers and the volume of flow in them is enormously reduced. Reduction of volume means reduction of velocity, and reduction of velocity means deposition of silt. (2) Reduction of velocity has another effect, *viz.*, that the high tide levels in the upper reaches of the rivers and estuaries are considerably raised. (3) The prevention of the full flow of the large volume of water necessary to cover the land not only checks the process of scouring in the rivers and *khals* and brings about their deterioration, but also leads to water-logging in the entire area causing malaria. (4) As the river-bed rises on account of the rivers being confined by the protective marginal embankments, the latter have to be continuously raised and strengthened. This in turn necessitates control or entire exclusion of discharges into the branches leading into the protected areas, as otherwise not only will these branches offer easier courses for the river but owing to better slopes available along them they will always be a source of frequent devastating inundation of the area. Thus these branches are converted into dead or dying channels according as the supplies at the head are entirely cut off or controlled.

The experience of the last two decades in the tidal areas in Bengal clearly indicates that the embankments are caus-

¹ *Forward*, September 5, 1934.

ing terrible stagnation, and Nature retaliates swiftly and surely. A far more useful and legitimate method would be to depend upon natural river action for general land-raising and reclamation as well as scouring of the water-courses themselves. It is estimated that in not less than half a century land in the active tidal area may be thus silted up. Nor will this silting up be absolutely complete so that tidal action will cease altogether. For after areas have become raised by river action, the time will come after a course of centuries when the general surface will have again subsided sufficiently for river action to be again resumed. "The fundamental principle of anti-malarial engineering," observes F. C. Griffin, "is to get the water moving. Whether there is to be as much water as possible, or as little as possible, depends upon local conditions, but at all costs make it move. In the deltaic areas the best thing is to push out the stagnant water by means of the silt-laden water. If then our land-raising operations are to be nullified some hundreds of years hence by land subsidence, we shall in the mean time be able to live on the land in health and happiness."¹

Natural Divisions of the Active Delta. The New Delta might itself be divided into two sub-regions: (1) the upper portion of the deltas, which comprises the districts of Dacca, Mymensingh, Faridpur and Tipperah, (2) the lower delta which comprises the districts of Bakarganj, Noakhali, Khulna and Chittagong, on the shore of the Bay of Bengal. It is a region of tidal waters, which, distributed through an endless chain of connected channels, eventually merge into the brackish estuaries of the Meghna and Haringhata. The lower delta where it borders on the Bay, becomes a

¹ A lecture delivered at the Institute of Engineers, Bengal; also Man Singh's article on "Flushing Old Rivers," *Amrita Bazar Patrika*, October 12, 1935.

labyrinth of creeks, and river swamps, running through the dense forests of the Sundarbans,¹ and exhibiting during the annual inundation the appearance of an immense sea. In the vast paddy-growing plains to the north of the forest belt, the villagers build lines of low mud embankments along the edge of every channel, which preserves their fields from inundation during the rains. The navigable streams that fall into the Ganges intersect the country on all sides and afford abundant facilities for internal communication. In many parts boats can approach over flooded marshes or by rivulets and watercourses, to the door of almost every cottage. The lower delta is the richest and most productive portion of Bengal. The region of brackish tidal waters, full of dark woods and muddy creeks, suggestive of fevers and crocodiles, is now much less in extent than in former years, and cultivation is still advancing all along the face of the Bay. Such extension of the pioneer fringe into the Bay is not without its risks and drawbacks. In the tidal area of Bakarganj, Jessore, Khulna and 24-Parganas, the reclamation of land by marginal embankments has led to the silting up and deterioration of the rivers and *khangals* once forming the natural drainage. This has brought about local agricultural decadence and decline of population ; while the obstruction of the courses due to the silt deposit along the entire channel and formation of sand banks at the mouth has raised the high-tide levels in the estuaries as well as the upper reaches of the rivers, and bores have become a menace to the riverine people. In parts of these tidal areas storm-waves lead to breaches in the embankments and to consequent infiltration

¹ The term is derived, according to Pargiter, from Samundar or Samudra-ban, *i e.*, sea forest, a name peculiarly appropriate for this tract. The derivation from the Sundari tree is doubtful since the tree is not found in many areas of the Sundarbans.

of salt water, which pushes back the frontiers of cultivation. The unreclaimed forests and swamps are small in Khulna and Bakarganj in comparison with those of Jessore or of the 24-Parganas ; the former districts are much more cultivated, owing to their higher level and to the large quantity of fresh water brought in by the Madhumati, Ganges and the Meghna. Between October and December the water surrounding the island of Kukri Mukri, which is almost in the Bay of Bengal, is perfectly fresh.¹ Similarly, in the Khulna Sundarbans there are innumerable *bils* at the heads of the rivers and owing to a large supply of water from the Ganges which concentrates at Khulna the waters turn sweet in the flood season. But even here as the construction of marginal embankments proceeds apace, it gradually prevents the *bil* spill, raises tide levels and kills off the rivers, and, as Adams Williams observes, "it would not be possible to cultivate the land except by reducing the water by pumping." A detailed study of the tidal conditions in the delta shows that there is an area of elevated tides to the south-east of Calcutta in exactly the place where reclamation has advanced the most; further east the tides run much lower and there is a direct relation between reclamation and high tides.²

Making of Bengal by the Rivers. Thompson estimates that from the lower reaches of the Hughli in Western Bengal to the fringe of the western uplands is barely 50 miles. In the Chittagong division, the newest delta formations are nearer still to the hills. Through Central and Northern Bengal, on the other hand, the space which corresponds to the distance between the Sundarbans and

¹ Beveridge : District of Bakarganj, pp. 23, 160.

² *Vide* Adams Williams : *Rivers and Drainage System of the Gangetic Delta*.

foothills of the Himalayas is not less than 300 miles. In the Dacca division the space is reduced to half by the appearance of the Garo Hills, 100 miles south of the latitude of the southernmost Himalayas and the intrusion of the estuary of the Meghna, with its tides nearly another 100 miles inland from the open sea. Practically the whole province is delta, and the character of its formation in any locality varies with its position relative to the outer edge, which is pushing slowly forward into the sea, and the hills which frame it on other sides; in other words, varies according to its age. Geologically speaking, the alluvial accumulations on the Ganges plain are very recent. Such deposits have been penetrated by borings in low places below the sea-level. The boring at Calcutta reached a depth of 481 feet without signs of either a rocky bottom or marine beds, while fragments of fresh-water shells were found as low as 380 feet below the surface, and coarse pebble beds were met with throughout the lowest section of the bore-hole; "showing that the present site of Calcutta was near the margin of the river valley, which has undergone depression accompanying the accumulation of alluvial material." Another boring, in the Middle Ganges plain at Lucknow, was carried down to nearly 1,000 feet below sea-level with no further sign of an approach to the bottom than was shown by the appearance of coarse sand near the end of the hole.¹ Similarly, the Sundarbans soil, as ascertained by boring, shows how ancient is the soil on which the forest grows; it tells of wonderful changes in the face of the once deep valley now filled up by the deltaic alluvium, hundreds and hundreds of feet in depth, when the ocean sweeping round the base of the Himalaya mountains covered what is now the valley of

¹ Imperial Gazetteer, Vol. 1, p. 100.

the Ganges and joined the sea at the mouths of the Indus.¹ At the sea-front convulsions and subsidences as well as gradual reduction of the level of the delta were experienced, leading to the submergence of important historic marts and settlements.

A few decades ago a whole forest of large Sundari trees was found standing as they grew only ten feet below the surface when excavating a tank at Port Canning. Their timber showed no decay indicating that no very great period of time has passed over that submergence. Col. Gastrell observed in this connection : " If the present level of their roots could suddenly become the level of the country, the whole Sundarbans would be under water. At a lower level than these trees, beds of a peaty mass composed of decayed and charred wood are pierced in Calcutta, Hughli, Dum Dum and elsewhere, at a depth varying from eight to eighty feet." ² It is probable that storm-waves and earthquakes as well as general depression caused by the continually increasing weight of the super-incumbent forest on the liquid mud are all responsible for subsidence of a large portion of Sundarbans, where ancient ruins and sites are found scattered here and there and for the bulging out of a portion of the delta seaward. Steatite seals and punch-marked coins belonging to the first and second century B.C. have been discovered in certain villages in the Twentyfour-Parganas, indicating the lower western delta as the seat of one of the earliest settlements in Bengal.³ When we remember that the annual film of the deposition laid down at

¹ Major Sherwell : *The Gangetic Delta, Calcutta Review* Jan., 1859.

² *Vide* Hunter : *Statistical Account of Sundarbans*, p. 292 ; Kalidas Datta : *The Antiquities of Khari and the Sundarbans*.

³ R. D. Banerjee : *Descriptive List of Sculptures and Coins in the Museum of the Bangiya Sahitya Parishad*, p. 16.

high water is but a fraction of an inch, or at most a few inches thick, the long period involved in the development of the plains on which Lucknow and Calcutta have been built will also be realised. The accompanying table shows the erosive action of the larger rivers of the world :—

Name of River.	Area of Basin (sq. miles).	Annual Discharge of Sedimentation in cubic feet.	Area of Delta in sq. miles.	Rate of Erosion of a foot of rock in years.
Ganges (Upper)	143,000	6,369,076,440	60,000	823
Mississippi	1,147,000	7,468,694 400	12,300	6,000
Hoang-Ho	700,000	17,520,000,000	...	1,464
Nile	2,800,000	720,000,000	9,000	292

The changes in the formation of the country, which take place very gradually over the space of 300 miles between the sea-face in Khulna district and the foothills in Jalpaiguri, are reproduced much more speedily in passing northwards through the Dacca division and north-westward through the Burdwan division, and only in miniature in the Chittagong division, where the eastern hills come close down to the sea. The Dacca division has been in particular the scene of kaleidoscopic changes of landscape brought about by the great rivers and their tributaries. Dacca has been for some centuries the meeting place of two entirely different river systems, which have played their part in the formation of the Bengal delta. The Ganges carries down the drainage of the upper plains from the north-west, and the Brahmaputra and the Meghna are fed by the waters of the Assam hills and the Himalayas to the north and north-east of Dacca. The Ganges and its tributaries have played the chief part in modern times in raising the general level of this region, and within the last century the Brahmaputra has mingled its waters with the Ganges. The direction of the first river system is from north-east to south-east with a strong

tendency to alter the direction from west to east, the direction of the latter system is generally from north to south. Thus a process of land building and unbuilding has been carried on ceaselessly and strenuously by the rivers and their tributaries. Land building and unbuilding in Bengal have thus accompanied an eastward shift of population and prosperity, which has been accelerated by the eastward march of the Padma, and the deterioration of the rivers of Central Bengal since the middle of the 16th century and by the shift of the great rivers eastwards in the estuary south of Noakhali and west of Chittagong. It was not, however, until the middle of the 18th century that colonisation and settlement in the lower delta made a marked progress. It is only during the last fifty years that there has been a remarkable extension of agriculture in the eastern districts accompanied by a doubling of the population and this eastern march has gone on in *pari passu* with the deterioration of the river system and of agriculture in the central and western districts. Throughout Bengal the appearance and character of the countryside follow the changes in the local river system and formation of the soil, though the reproduction of these changes is tinted throughout by the excess rainfall to the east diminishing to the north and west and appearing again under the Garo Hills and the Himalayas. It might be expected that the changes in the constitution of the population almost entirely dependent on the productivity of the soil would be of the same character, and, generally speaking, this is so. Variations in density in Northern and Central Bengal, excepting where they come under the influence of the commercial and industrial activity of which Calcutta is the centre, take place very much more slowly than in either Eastern or Western Bengal, and the population retains the same character over a far wider area.¹

¹ Census of Bengal, 1921, p. 52.

Bengal before History. Throughout the dim past the character and appearance of the landscape of Bengal have been constantly transformed, leading to changes in the fertility of the soil and indirectly in the composition of the population. At first the sea washed the shore on the slopes of the Himalayas. The rivers from the hills in the north and the east continually brought a deposit of silt, and the earliest land raised in this manner was a belt in the position of the present Sundarbans, where the tide, sweeping round the coast of Bengal, effected a junction. A network of islands gradually emerged from the sea and the lagoons between them were converted into a series of vast inland lakes. On account of the rise of the level of land nearer the sea, the country nearer the hills received larger quantities of silt and gradually became firm land which could maintain an agricultural population. Outcrops of such old alluvium, which consist of a more or less coarse red laterite soil, begin in the Rajmahal district of Bihar and follow a course through the districts of Maldah, Rajshahi, Pabna, Dinajpur, Rangpur and Bogra. The old alluvium appears again on the eastern bank of the Brahmaputra in the Assam Valley, and also in an extensive tract known as the Madhupur jungle in the Dacca and Mymensingh districts. The upper layer here is stiff red clay, but underlying this is a layer of red sand, which very much resembles the sand so common in the beds of the Ajai, Barakar and other rivers in Western Bengal, which fringe the Chota Nagpur plateau. Geologists point out that the red clay of the Madhupur jungle is the low-level laterite. Another tract of the old alluvium occurs in the Chittagong and Tipperah districts, while in the west the whole of the Burdwan division consists of the old alluvium. The origin of 'rangamati' (red clay) scattered throughout the upper portion of the delta probably is that it is the relic of an alluvium deposited by rivers that flowed long before the present river system now found in Bengal came into existence.

The red clay of Rangpur, Burdwan, Murshidabad and Madhupur jungle is very different from clay brought down by any of the Himalayan rivers, while the underlying sand bears no resemblance to the micaceous white sand these deposit.

Land-marks of Aryan Colonisation of Bengal. There is no doubt that the first settlement of Bengal was in the old alluvium tracts. The most ancient inhabitants were described as fishermen and unclean folks in ancient literature. We come across the name of Vanga in the Aitareya Aranyaka of the Rig Veda, the Epics and the Puranas. Pargiter is of opinion that Vanga at this time comprised only the modern districts of Murshidabad, Nadia, Jessore, Pabna, Faridpur and parts of Rajshahi. We come across another geographical name, Sumha, in the Brihat Samhita which places it between Vanga and Kalinga. Sumha is also mentioned in the Mahabharata and some Puranas. It appears that in the Brahmana period (800-600 B.C.) Bengal remained outside the pale of the Indo-Aryan civilisation. According to a legend in the Satapatha Brahmana, Videha first came under the influence of Aryan culture through Madhava. Bengal's turn came much later. For even in the time of Patanjali, the eastern frontier of Aryavarta was mentioned as Kalakavana, which comprised the Rajmahal hills. In the Sutra period (600-200 B.C.) Aryan colonisation progressed but was not completed for we encounter the repeated warning that any person visiting the Pundras and Vangas should perform *prayaschitta* or a purification ceremony. Some historians now conclude that colonisation and Aryanisation of Bengal were completed under the Mauryas, Bengal definitely forming a part of the Maurya empire as the old Brahmi inscription of Mahasthan clearly indicates.¹ Bengal had a full share of the Buddhist and

¹ Surendrakishore Chakrabarty : Ancient Bengal and Aryan Culture, *Advance*, Puja Special Number, 1935.

Jaina revivals. Later on Bengal became an integral part of the Gupta empire, the eastern frontier of Samudragupta's empire (375 A.D.), being the Brahmaputra and the rulers of Samatata, Davaka (perhaps Dacca, Eastern Bengal), Kamarupa, Nepal and Karartipur rendering him allegiance. Rarha occurs in its Prakrit form of Ladha in the Acharanga Sutra of the Jains. It is identical, as Nilkantha has remarked, with the Sumha of the Epics and corresponds to the later political division, Karna Suvarna, or the country, west of the Bhagirathi. Varendra or Varendri occurs in the Rama(pala) Charitra and is identical with Pundra or North Bengal, lying between the Ganges and Karatoya. Hiuen Tsang (629-640 A.D.) includes Paundra Vardhana in Central India, and mentions Samatata, Karna Suvarna and Tampralipti and Kamarupa as geographical divisions of eastern India. Majumdar observes: "We have Sanskrit (or Sanskritised) names of the first three of the four divisions of Bengal and their early uses show the antiquity of those names."¹ In medieval times Bengal's divisions were Paundra-Vardhana-bhukti or Northern Bengal, bounded on the east by the Karatoya and on the west and south by the Ganges; Kankagram-bhukti or Northern Rarha, bounded on the south by either the Ajaya or the Damodar; Bardhamana-bhukti or Southern Rarha, bounded on the north by the Ajay and on the south and east by the Bhagirathi and the Adi-Ganga right down to the Bay; Danda-bhukti or the marches separating Bengal from Kalinga, full of forests, bounded in the east by the Dwarakesar, and on the south by the sea and the river Suvarnarekha. The political divisions under Ballala Sen (1119 A.D.) were Vanga and Varendra to the north of the Ganges, and Rarha and Bagri to the south of the river. Vanga was then restricted to Bengal and comprised the tract bounded by the Brahmaputra in the west, the Meghna or the

¹ S. N. Majumdar : *Ancient Geography of India*, pp. 73-74.

Meghananda in the east, the Ganges on the south and the Khasi hills on the north. Varendra was ancient Paundra Vardhana. Bagri was separated from Rarha by the Jelinghi and formed a *mandala* of the Paundra Vardhana-bhukti, according to the Khalimpur grant of Dharmapala (780-810 A.D.).¹ From the bank of the Damodar in Rarha extended vast forests in South-West Bengal up to the limit of Vishnupur. The jungle was, indeed, the natural frontier of the Hindu kingdom against Muhammadan incursion. A part of this forest was traversed by the religious leader Chaitanya in 1510 and by his disciples after another century as they crossed over to Bana-Vishnupur. Included in the Bardhamana-bhukti was Bettada-Chaturaka, covering much of Howrah and the 24-Parganas which were not settled even only four centuries back. Towards the south Khari (Sanskrit, Khata or channel), Samatata (shore of the sea) and Bagri represent the latest deltaic formation. The last term Bagri is probably the modern equivalent of ancient Vala-Valabhi or Vyaghratati (the tiger coast) and of Bhati or ebb-tide land (which is phonetically recalled by the word Bada) of the Akbarnama, and Grant's Analysis of the Finances of Bengal. These divisions are identified with the entire active delta of the Ganges and the Brahmaputra, infested with tigers, and inundated throughout by silt tide and their frontiers varied in different epochs with the vicissitudes of struggle between the land and sea. As population and settlement expanded in the up-river areas, the mass of agricultural tribes and castes, who were the original settlers were driven into the forest-belt, which separated the cultivated tract from the sea. With increased pressure of population even the ruling and superior clans of the Rajputs gradually pushed their way to the more fertile soil of the elevated tracts in the lagoon situated on the banks of the

¹ Vide S. K. Chakrabarty: *Ibid.*

greater rivers. The outward thrust from Magadha to Bengal was no doubt facilitated by the successive foreign immigrations and conquests of the then most fertile and prosperous portion of the Ganges valley with the imperial capital at Pataliputra. Mention may be made of the colonisation of Karna Suvarna in Western Bengal by Sasanka from Magadha in the 7th century, and of Magadha Deva in Rarh and Narayana Deva in Mymensingh in the 13th century. The Muhammadan incursion speeded up the colonisation of eastern and southern Bengal in the later centuries. The Sena kings having lost their kingdom in the north carved out new territories in Southern and Eastern Bengal whence they opposed the fresh advance of the Muhammadan conquerors. At the time of the death of Bakhtiyar Khilji, only a portion of Varendra came under Muhammadan rule, the descendants of Lakshmana Sen still holding their sway over Southern and Eastern Bengal. In 1293 Saptagram first yielded to the Muhammadan arms, but Southern Bengal bordering the sea-face still held out under the Hindu chiefs. It was not till the middle of the 15th century that the whole of Southern Bengal was subjugated; but such centres as Vishnupur, Burdwan, Jessore, Khulna, Vikrampur, Chandradwip and Tipperah could preserve their independence with more or less success, and these still remain the strongholds of the upper-caste Hindus in Bengal. From the 12th to the 15th centuries the Muhammadan invasion scattered many ruling clans and castes of the upper valley all over Bengal, not to speak of the agricultural tribes and castes who all scrambled for land after the Muhammadan conquests.

The history of ancient migration and settlement is obscure but it is apparent that Champa (near Bhagalpur), Monghyr (ancient Mudgiri), Pundra in the neighbourhood of the Rajmahal hills, Lakshnaoti or Gaur on the bank of the Ganges as she debouches from the hills, and turns to the

south, Mahasthana in the district of Bogra, Bardhamana (Burdwan) and Bhuriscreshti bordering the plateau, Bishnupur and Bihar in the district of Bankura, Karna Suvarna and Kankagram in the district of Murshidabad, Nagar in the district of Birbhum, Saptagram in the district of Hughli, Ambikanagar, Tamluk and Ghatal in the district of Midnapur, formed stages of the steady advance of civilisation towards the lower delta overgrown with forests and intersected by marshes and swamps. In Eastern Bengal Vikrampur, Davaka, Sabhar, Rampal, Devaka, Mymensingh, Patikara, Karmanta, Bakla and Chittagong were outposts of ancient settlement and civilisation in the lower reaches of the mighty rivers in successive epochs. Hwen Thsang's accounts (629-640 A. D.) indicate that Bengal was then divided into Kajangala (probably Murshidabad and Birbhum) which was low and moist, yielding good crops, Paundra Vardhana (Northern Bengal) with its capital probably at Mahasthana on the bank of Karatoya which had a flourishing population "with tanks, hospices and flower groves," Samatata on the delta of the Ganges and the Brahmaputra with its capital at Karmanta near Comilla; Tamralipta or Southern Bengal, with its capital at Tamralipti (modern Tamluk) standing on the Bay and where farming was quite good and fruits and flowers abounded; and Karna Suvarna or Western Bengal, the ancient capital of which is identified with Rangamati Kansona on the Bhagirathi in Murshidabad whence Sasanka reigned over Rarh, Gaur and Magadha in the later part of the 6th century. Karna Suvarna was described by the Chinese traveller as being well inhabited, full of rich people and having a temperate climate. Maurya and Kushan coins were discovered in Tamluk, while Kushan and Gupta coins were found in Karna Suvarna-Rangamati. Various Gupta coins have been found here and there in other districts in Bengal, Burdwan and Faridpur and

Hooghly (in Mahanand and Madhavpur), Jessore (in Kotali-para), 24-Parganas (in Kalighat).¹ Both Hiuen Tshang and It-sing (673-688 A. D.) refer to another important dynasty of rulers at Karmanta, identified with Bara Komta, 12 miles west of Comilla, viz., the Khadghas, whose kingdom, according to Bhattasali, comprised the districts of Tipperah, Noakhali, Barisal and parts of Dacca and Faridpur. No doubt in those days (end of the 7th century A.D.) settlement was more or less restricted to riverine marts and cities, the surrounding country being yet full of fens and marshes. In the 11th century we come across some new political divisions of Bengal, some of which remain unidentified; Kotatabi (this is the Kota-desa of the Ain-i-Akbari, i. e., Garhjata); Danda-bhukti (south of Midnapur); Vala Valabhi (Bagri); Apar-Mandar (Garh Mandaran); Kujabati; Tailakampa (Telkupi in Manbhum); Ucchala; Dhekkari (on the Ajai in Northern Rarha); Kayanga Sankatgram; Nidravala; Kausambi (in Rajshahi) and Pada-barwa.² That a portion of the Sundarbans extending from the banks of the Bhagirathi on the west to the borders of Noakhali was prosperous even several centuries earlier is clearly indicated by the discovery of Gupta coins at Kalighat and Gupta images of the Sun and Nrisingha at Jaynagar. Devapala's inscription indicates that Gopala (740-785 A.D.) could extend his kingdom up to the limits of the sea-face, where his war elephants were set free to roam freely. Dharmapala's (785-820 A.D.) retinue later could enjoy the privilege of a ceremonial bath in the holy waters of the sea. The inscriptions of Lakshman Sena indicate that a large portion of the 24-Parganas was in those days included in Bettadda-chaturaka and the

¹ R. D. Banerjee. *Banglar Itihas*, Ch. IV.

² Vide Dinesh Chandra Sen: *Brihat Vanga*, p. 222.

³ *Ibid.* Vol. I, pp. 266-67.

south-eastern portion of the Sundarbans came under Khari-Mandala. Ancient Buddhist relics and images of Barahi and Hara-Gauri have been discovered in the district of Noakhali. No doubt the entire sea-face of Bengal from Midnapur to Noakhali had in the historical period undergone a subsidence, causing the ruin of some of the earliest settlements in lower Bengal, including probably the port of Bengala, and re-establishment of the jungle and colonisation had to begin anew in the 15th century.

Stages of Settlement in the Medieval Times. We read in the Tabakat-i-Nasiri (1243) that the kingdom of Lakshmanavati had two divisions: first, the western division called Rarha with the important town of (Raj) Nagore in Birbhum, and second, the eastern division, called Barind with the town of Devacot (18 miles south of Dinajpore). A causeway was built by Sultan Ghiyasuddin extending from Gaur towards east and west and reaching both these cities. The country on both sides of this road was submerged in the rainy season. The distribution of Bengal's important markets in the medieval times, as indicated by the merchant prince Chand Sadagar's reference to the fourteen emporias of commerce which he used to frequent, throws light on the progress of colonisation and settlement in the lower delta. Champa (in Bhagalpur), Ajodhya (in Birbhum or Bankura), Gaur or Kanchannagar (in Malda), Karna Suvarna and Golahat (in Murshidabad), Champai (in Burdwan), Saptagram (in Hughli), Chandnia (in Bogra), Sanaka (in Dinajpur), Dhubri, the banks of the Ranjit, Harischandra Raja's seat (in Rungpur), Sabhar (in Dacca), Champaknagar (in Tipperah) and Chittagong.¹

The Moorish traveller, Ibn Batuta (1328-1354), entered Bengal through Sudakawan, identified with Chittagong

¹ The identifications are those of Shiva Chandra Sil, Sahitya Parishad Patrika, 1327, XVII, 4.

(Chatganw), which is described as a large town on the coast of the great sea. He adds: "Close by it the river Ganges and the river Jun (the Jamuna which obviously represents the Brahmaputra) unite and discharge together into the sea." He also describes another river, the Blue river, which descends from the Kamaru (Kamrup) mountains, and is used by travellers to Bengal and Lakhnaoti. An exceedingly large and beautiful city named Habanq is also mentioned. Habanq is identified with Habang, a little to the south of Habiganj on the left bank of the Barak, one of the headwaters of the Meghna. "On its banks there are water-wheels, orchards and villages to right and to left like the Nile in Egypt." Sailing down the river for fifteen days the traveller reached the city of Sunurkawan (Sonargaon) whence he embarked in a junk for Sumatra.¹ Ibn Batuta's description clearly indicates that by the 14th century the banks of the Meghna were already populated. "We travelled down the Blue river for 15 days between villages and orchards, just as if we were going through a bazaar." Ibn Batuta's description of the Jun or the Brahmaputra's confluence with the Ganges near about Chittagong close to the estuary, is exceedingly significant as indicating the ancient and now forgotten course of the Brahmaputra. The latter has ushered into the making of Bengal's economic history only in very recent times, dating not more than the beginning of the 19th century. Thomas, from his discussion on old coins of Bengal, concluded that so early as the 12th century there was free commercial intercourse between the south-eastern sea-port of Bengal and the Arab sea-ports. It is probable, however, that only the riverain tract or the seaboard was populated; the interior was more or less a region of marshes and wastes devoid of habitations. Barani, writing as late as the 14th century, thus refers to

¹ See Gibb: *Ibn Batuta*, pp. 267-77 and 366.

Bengal as a "land of swamps." Ralph Fitch (1583-91) mentions that in the country of Bengala there are "many tigers, wild buffes and great store of wild fowls." He visited Kuch Bihar, and returned thence to Hughli. He writes: "We went through the wilderness, because the right way was full of thieves, where we passed the country of Gouren (Gaur), where we found but few villages but almost all wilderness, and saw many buffes, swine and deere, grasse longer than a man and very many tigers." Thus Northern Bengal seemed to have been full of forest in the 16th century.

The lower delta had a fresh spell of colonisation under the Muhammadans long before whose advent the Sundarbans, especially in the west, were, as we have pointed out, full of prosperous settlements. Some of these that have been unearthed indicate evidences of prosperity in the sea-face of Western Bengal that date from Gupta, Pala and Sena periods. The Muhammadan historians never use the term Sundarbans, but give the seaboard from Hughli to the Meghna one name, Bhati, which signifies lowlands overflowed by the tides. Isa Khan Afghan was overlord of the Bhati during Akbar's reign. But at that time the Sirkars of Mahmudabad and Khalifatabad, which included Faridpur, Jessore and Noakhali still abounded with elephants and were dense with jungle.¹ Sirkar Mahmudabad was apparently established sometime between 1426 and 1457 and Sirkar Khalifatabad between 1450 and 1458. When Khan Jehan Ali arrived in Central Bengal in the 16th century, south-west Jessore was covered with jungle. It was he who reclaimed large areas of the Sundarbans. He died when Nasir Shah was king of Gaur. Other kings gave their names to different parganas of

¹ See S. C. Sen: Report of the System of Agriculture Dacca.

Jessore suggesting the time when these came into existence :—

Name of King.	Name of Pargana.
Yusuf Shah, 1494	Yusufpur
Syed Hossain, 1494	Syedpur
Nasrat Shah, 1520	Nasratshahi ¹

Portions of Faridpur, Jessore and Noakhali were, however, included in Fatehabad Sirkar of which an early mention is found in Bejoy Gupta's *Manasa-mangala* written at the end of the 15th century. In Akbar's reign an attempt was made by his general to conquer Fatehabad, Hobeli and Bakla. Fatehabad is described as the most important area in the kingdom of Gaur by a local poet and its capital of the same name, which is indicated in De Barros' map (1550), is said to be buried in the big *bil* known as the Dhol Samudra.² Vikrampur was of course settled much earlier, the area including the south-eastern portion of Dacca, and the north-eastern portion of Faridpur and extending in the east up to the bank of the Lohitya or the modern Meghna. The Jesuit missionary, Fernandus (1598), mentions the danger of tigers on the way from Hughli to Sripur and Chittagong, travelling probably by some of the inland waterways. Next year (1599) Fonseca came to Bengal and in the account of his journey from Bakla to Chandeean referred to herds of deer and monkeys which he came across in the ordinary route through the Sundarbans. Blochmann after a comparison of Todar Mall's rent roll and the old Portuguese and Dutch maps comes to the conclusion that in the 24 Parganas and Jessore the northern limit of the Sundarbans, omitting recent clearances, was in the 15th

¹ Momen : Settlement Report of Jessore, p. 85.

² Biseswar Bhattacharyya : Fatehabad, Sahitya Parisad Patrika, XXXIV, 4.

century much the same as when he wrote (1873). But considerable progress must have been made in Bakarganj district, as we see from the numerous accessions, during that period to the imperial rent roll.¹ The reclamation of jungle and swamp in Khulna though recent has now almost reached the same level as in Pakarganj district. Towards the close of the 16th century Pratapaditya established his kingdom in the Sundarbans.

Progress of Settlement and Agriculture in the Last Two Centuries. The *Chahar Gulshan* (1720) gives the total measured area of Bengal as 334,775 bighas only as compared with Bihar's 13,152,845 bighas. We read in the *Khulasatul-Tawarikh* (1695) that wild elephants roamed over the forests of Khalifatabad. Blochmann identifies this with southern Jessore, Khulna and Western Bakarganj, which would indicate that this tract was not yet reclaimed during Auranzeb's reign. Fitch (16th century) described the houses of Sinnergan (Sonargaon) as having a few mats round about the walls and doors to keep out the tigers and the foxes which seemed to have infested the tracts at that time. Bakla or Bagla at that period fringed the seacoast. "There is a forest in the environs of its port," runs the description. Bakla has been identified with Bakarganj and Dacca, areas which then were subjected to the tidal waves of the estuary. A commercial treaty was signed between the Raja of Chandradwip or Bakla and the Portuguese of Goa in 1559 by which a monopoly was sought to be established for Portuguese trade in Bengal with this port to the exclusion of all sea-ports "from Paigas to Bakla."² We have already mentioned that Blochmann on the basis of the detailed list of the mahals in Sircars Satgaon and Khalifatabad

¹ Geography and History of Bengal, J. A.S. B., 1873.

² See also Surendranath Sen : *Studies in Indian History*, pp. 4-5.

of Todar Mal's rent roll, positively concludes that in 1582, the northern outskirts of the Sundarbans corresponded almost exactly to the northern boundary of the jungle marked on modern survey maps. The continual invasions of the piratical Arakanese, which even thwarted the vigilance of the numerous Moghul fleet as well as storm-waves, checked the expansion of permanent settlements. In 1584 we read that a terrible inundation took place in this Sircar in which many houses and boats were destroyed and two lacs of people perished. In the readjustment of Bengal by Shuja in 1658 the Bakarganj portion of the Sundarbans was for the first time mentioned, under the name of Muradkhana or Jeradkhana. This Sircar was divided into two parganas only, Akla for pasturage and Bunjer for forest produce, with a light assessment of *Sicca* Rs. 8,454. Fawcus observes: "It is doubtful whether the Sircar covered the whole of the productive area of the Sundarbans or only the eastern portions, as is suggested by the ultimate inclusion of the Sircar entirely within the Neabut of Dacca, but its existence is of interest as the first example of the recognition of an area assessable to revenue but not fit to bear the full burden of cultivated land."¹ The tide of reclamation much advanced in the next two centuries, and to-day Dacca is beyond the reach of the devastation caused by bores from the estuary. Accordingly it appears that within only two centuries the Ganges almost completed its work of land-making in what is described as the Bakarganj area of the Sundarbans. The land here is high and the river water comparatively sweet, no embankments being here necessary as in Jessore and the 24-Parganas to protect the crops. Thus in Bakarganj the agricultural settlements have extended almost down to the sea. This has its obvious drawback. A belt of forest serves

¹ Surendranath Sen: *Studies in Indian History*, pp. 4-5.

as an admirable breakwater against the ocean. Thus while the low jungle breaks the force of the tidal wave before the inundation reaches the cultivated tracts between the Hughli and Matla rivers, the extension of the frontiers of cultivation in Bakarganj has removed the natural barrier. The northern part of Bakarganj is the oldest, as being the farthest from the sea, and here we meet with some ancient names, such as Gaurnadi. Chandradwip, however, which was the name formerly given to much of Bakarganj, implies that it was in or near the sea and Selimabad, the name given to the western part of the district, seems to imply that the country was not redeemed from jungle till the time of Prince Selim, the son of Akbar. Salt was manufactured only a century ago at places which are now far inland, while the former nature of the country is also indicated by the word *kati* (cutting or cleaning) which we find affixed to the names of so many villages in the interior.¹ Bakarganj is still exposed to the cyclones and storm-waves, now and then throwing back the advance of settlement, which has reached as far as the seacoast. Yet the reclamation of land from the sea goes on in much the same manner. Between 1830 and 1872 as much as 276,804 square miles (177,152 acres) were cleared in the Bakarganj Sundarbans. By 1872 about one-half of the Bakarganj Sundarbans was cleared. Between 1872 and 1912 the other half came under cultivation, only the low jungles and dunes facing the sea remaining unreclaimed.

Reclamation of Land—The Sundarbans. Cultivation first begins in *chars* or sand-banks thrown up in portions of the inland sea, which are gradually filled by the detritus brought by the rivers. The *chars* remain in a condition of liquid mud for years, but as soon as the mud is out of water sufficiently long to allow of the growth of

¹ Beveridge : District of Bakarganj, p. 250.

rank grass, it develops quickly into land, since the grass collects and holds the silt which is borne over it. On the *diaras* of the Meghna, which is one of the greatest *boro* tracts in Bengal, the soil is rich in organic matter, and is kept moist by being flooded at every tide. This class of paddy is generally transplanted, but there are one or two varieties of it that are sown broadcast.¹ The mud bank is cultivable very early where not too close to the sea, and bears a splendid crop of *boro* rice. Near the sea no crop can be grown until the level of the land is above the tidal level of the cold weather, and even then it takes several years to wash the saline deposit out of the soil. Where islands are formed their level rises rapidly until the centre is almost as high as the level of the highest flood, while the lagoons which separate them become gradually shallower, until at last we have a stretch of high and dry land, the centre of which is cultivated and inhabited, the circumference falling away in dense forests into shallow lagoons. Many of the islands of Bakarganj, Manpura, Shahbazpur and the islands of the Galachipa archipelago, are now higher than the mainland of Bakarganj, and contain fewer streams and watercourses. Thus the *aman* crop, which is the chief staple crop of the mainland, cannot grow here, but *boro* paddy grows abundantly. *Jhils* or marshes also undergo the same process of reclamation. In some of the swamps the surface growth of aquatic plants mixed with drift weeds, grasses and rice stalks increases annually and in process of time a crust is formed capable of supporting human beings and on which rice is cultivated in the dry season.² "It is dangerous to tread on this shaking surface except where the straw *hiras* or small retaining embankments which mark the fields show that people have been

¹ *Tarikh-i-Firuz-Shahi*, Elliot, III, p. 297.

² Hunter : *Imperial Gazetteer*, 2nd Edition, Vol. I, p. 446.

before.” A few of the swamps, which extended from 20 to 30 sq. miles in area, have greatly diminished in size by coming under the plough. The smaller *bils* which serve the very useful purpose of village boundaries are even more easily encroached upon. The inhabitants on either side of the *bil* cultivate as far as they prudently can, and abandon only the centre to jungle and water-fowl.¹ At first the clearings in the marshes and forests attract cultivators, not settlers. After collecting the harvest in their boats, they return with bullock and plough, abandoning their fields to birds and wild beasts. The occupation is temporary and precarious; when a storm-wave comes all is lost, and the forest again asserts itself against man. The conquest of forests and marshes by the cultivator still proceeds apace in the great Sundarbans region which extends for about 170 miles along the sea-face of the Bay of Bengal from the estuary of the Hughli to that of the Meghna, and runs inland to a distance of from 60 to 80 miles. From the 15th century man has carried on the work of reclamation here, fighting with the jungle, the tiger, the wild buffalo, the pig and the crocodile, until at the present day nearly half of what was formerly an impenetrable forest has been converted into gardens of graceful palm and fields of waving rice. Even crabs and river turtles—immense numbers of which are thrown on cultivated lands by the rivers—cause great havoc, and thus the fields at the water’s edge are fenced by brushwood and date palm branches. In fact deltaic cultivators have to spend weary nights in the fields especially about the time of harvests on sheds raised on a scaffolding of bamboos to scare away the beasts. In the district of Bakarganj, some of the clearings have now extended almost down to the sea. In Jessore,

¹ Pellaw’s article on the Physical Characteristics of Bakarganj, appended in Beveridge: *District of Bakarganj*, pp. 432-35.

Khulna, and 24-Parganas the tide of reclamation follows the course of the creeks, which open themselves into the great river, and the reclaimed spots are almost all known by the names of the *k̐hals* on which they are situated. After the clearance of the dense jungle, a *bund* or dike is erected round the settlement to keep out the salt-water. For the first five years paddy seeds are spread by means of a wooden peg driven into the soil. Then the plough is introduced but not the harrow, which is not admissible before the tenth year, because of the roots and stumps which render the soil yet uneven. Little of *aus* is grown in this tract and the common varieties of rice are *aman*, *boro* and *raida*. The last two are essentially crops of the lagoons and morasses. *Raida* has a characteristic which deserves mention. It is a floating paddy, whose stalks twist and interweave together into masses called *dhaps*, which are driven by the action of the wind from one field to another. These *dhaps* and their produce become the property of the owner of the field, who prevents their further migration by affixing them to his soil by means of a bamboo.¹ In later years the cultivator introduces plantains, areca, cocoanut and dates, until at the end of the fifteenth year the Sundarbans colony, standing on the brink of a broad creek, has become a thriving settlement. Agriculture after this takes the usual course of an ordinary district in Upper Bengal.² As the population of the districts immediately north of the Sundarbans expands, the work of reclamation slowly and gradually proceeds, and the train of woodcutters, hunters and low-grade cultivators is followed

¹ Ram Shankar Sen : Report of the Agricultural Statistics of Jessore District.

² For a history of the Sundarbans settlement see Ram Shankar Sen's Report of the Agricultural Statistics of Jessore, 1874 ; and Westland : *Jessore*.

up by the immigration of well-to-do peasants, traders and professionals. For within two decades the country becomes prosperous, and a large export trade in rice, betelnut, and cocoanut develops. The rainfall varies from 80 inches in the west to over 200 inches in the east. The agricultural danger is not from droughts, but from cyclones and storm-waves. On one October night in 1876 a storm-wave destroyed no fewer than 100,000 souls in the mainland portion of Noakhali, and on the islands of Sandwip and Hatia, or about 19 per cent. of the total population of these places ; while in Bakarganj district, Dakhin Shahbazar and some thanas of Patuakhali Subdivision were submerged to a depth of 10 to 45 feet and 124,000 persons were drowned, or died in the cholera epidemic that ensued. Though man has shown the greatest perseverance and fearlessness in the delta, yet, when the elements have chosen, the handiwork of several generations has been destroyed by a blow by storm-waves which occasionally sweep the rivers in the wake of cyclones. Yet the tiger and the crocodile have receded further and further towards the sea, and man has pushed his way into the primeval forest and ventured into dangerous-looking creeks running into the impenetrable darkness.¹ Even where he has been unable to found a hamlet, not daring to venture on shore on account of the wild beasts and the miasma of the forest, he yet lives in boats, and awaits the earliest opportunity to secure a local habitation and a name. Man's activity thus has entirely transformed the land surface over more than five-sixths of the Bengal delta. The upper portion of the delta was the first to become densely peopled, and developed a fine civilisation centuries before the Sundarbans country attracted settlers. A continual change of landscape has gone on throughout the

¹ For a vivid description *vide* the *Calcutta Review*, March, 1859. The account though old still holds good.

delta and such change is intimately associated with the vicissitudes of man's settlement. At first the embankments of the rivers, coursing their way through flat plains, are raised owing to the deposit of silt. The streams being confined to their courses raise the river-beds. Thus the rivers become silted up and deteriorate, and in the end are transformed into reaches of stagnant water, or lines of pools or swamps, choked with vegetation, which bring fevers, and depopulate ancient habitations. Lower in the delta rivers continually shift their channels. They always seek depressions, and in coursing through marshes and low-lands they take a little time to embank themselves. The low ground is gradually turned into rich alluvial land, immediately to be converted into waving fields of rice; while the rivers themselves open up new channels or cut and renovate old silted beds of dead rivers. Man continually shifts his plots of land and homesteads with the fluctuations of the landscape. Like the plastic, ever-shifting land, his scene, man is a victim of the whims and caprices of the river; but undaunted he still asserts and imposes his supremacy on the landscape, however hostile may be the elements, and however hazardous the situation. What Michelet said of Flanders may equally be said of the Sundarbans: "It has been created, so to speak, in defiance of nature; it is a product of human labour."

CHAPTER VII

CHANGES IN RIVERS AND PORTS IN THE 16TH CENTURY

Shifting Courses of the Delta. The Ganges though a relatively old river has proved a great rover and land-breaker in the deltaic region, where great shiftings of population and prosperity have taken place even within the historic period. The tract between Malda and Murshidabad was the ancient Ganges delta where the river split up into numerous spill channels, the most important of which appeared to be the Saraswati, the Bhagirathi and the Bhairab. Leaving the hills of Rajmahal the Ganges seemed to have passed northwards through the modern Kalindri, and then southwards into the lower course of the Mahananda, east of the ruins of ancient Gaur. There was also the south-eastern branch of the Ganges (modern Padma) the bifurcation being pretty old and shown in Ptolemy's map.¹ In the oldest of modern maps, De Barros' (1550) and Gastaldi's (1561), Gaur is shown on the west of the Ganges. Leaving Gaur, the main waters of the Ganges turned southward and flowed through the channel of the Bhairab (as Krittivasa, the reputed author, who flourished in the fourteenth century indicated), and from at least the twelfth century to the sixteenth century through the Saraswati into the Bay, while the ancient eastern branch of the Ganges is traceable in the chain of *jhils* and morasses, which extend from Purnea to the sea. The Ganges then forsook this course in favour of the channel through which

¹ Nordenskiöld: *Facsimile Atlas*, Plate Ichh. XXV. See M. M. Chakravarti: *Notes on the Geography of Old Bengal*, J.A.S.B., May, 1908.

the Bhagirathi now passes. The Kosi and the Ichhamati then came into existence, occupied portions of the forsaken channel of the Ganges, and flowed into the Brahmaputra. The Ichhamati, a name which is still used for different rivers in Dinajpur, Nadia, Jessore, and Dacca, became a most important river—probably the different Ichhamatis formed parts of the same river—and was all the way the continuation of the older course of the Ganges. On the banks of the Ichhamati the most ancient Portuguese settlements grew up. Rampal, the ancient capital of Bengal, was situated near the junction of the Ichhamati with the Brahmaputra. Not far from the river, Iswaripur, the ancient capital of Pratapaditya, was also located. Another ancient and important river in the east was the Karatoya. Before the Ganges or the Ichhamati flowed into the Brahmaputra, the Himalayan rivers united their waters and formed the Karatoya, which swept eastward of Barind. The Karatoya's greatness is mentioned in the Puranas; the river formerly formed the western boundary of the kingdom of Kamarupa, and appeared to have flowed independently to the sea. For hundreds of centuries the Karatoya was as important as the western river, the Ganges, whose main stream for hundreds of centuries flowed through the channel of the Saraswati and the Bhagirathi. Karnasuvarna, Kankagram, Navadwip, Katwa, Saptagram, Tribeni were ancient and famous cities on the banks of the latter channel; and the Ganga-Sagar, where the river met the sea, was a sacred place of pilgrimage. In the Pavana-dutam (12th century), Tribeni is mentioned as the place where the Bhagirathi and Jamuna rivers have separated. The maps of De Barros and Van den Broucke indicate that the Saraswati and the Bhagirathi bifurcated at Tribeni, and rejoined probably at Bator near Sibpur, the former channel passing through Chaumaha and Mandaran Bhitargarh, being navigable up to the deltaic port, Tamluk or Hijli, which

replaced the former city in the sixteenth century. Cantelli's map (1683), however, shows the Saraswati and Bhagirathi's mouths as entirely different, the former flowing into the sea independently. Towards the west, the direction of the Saraswati or the Bhagirathi was circumscribed by a belt of stiff clay and beds of nodular limestone ; but in the east the river changed its bed from time to time. The Ganges again shifted its course eastward, and its first important step in this direction was the Nava-Ganga. The river is marked in old maps all the way from Damorda on the Ichhamati, in Krishnagar district, to the morass in the Barisal district above the Haringhata channel. Above Damorda it passed through the Meherpur subdivision and the disconnected embankments known as the Laltakuri embankments in Murshidabad probably mark the site where it took rise from the Bhagirathi. In the 16th century the Ganges shifted its course further to the east and excavated the channel known as the Padma, which has now become the main course. It was probably the deflection of the Kosi, which was an easterly flowing river, to the west in the fourteenth and fifteenth centuries that led the pent-up waters to strengthen the channel of the Padma. Formerly the combined water of the Kosi, Mahanuddee and Atrai flowed into the Lohitya. Mighty changes took place in the course of these and other Himalayan rivers, which might have been due to the silting up of the drainage basins along the Himalayas by the debris from the hill slopes and sudden seismic disturbances, until these rivers swerved westward, discharged into the Ganges, and became responsible for the mighty force of the new channel of Padma. This eastward movement of the Ganges was also due to the denudation of trees in the jungle slopes in north and west, which led to an early silting up of the historic channels, Barendra as well as Rarha, North and Western Bengal being settled and populated much earlier. Not merely Barendra, which was

well covered with jungle until the middle of the last century, but also the Chota Nagpur hill slopes have largely been cleared for the cultivation of rice. The reckless deforestation of the plateau spurs to westward upset the regime of the rivers flowing into the Bhagirathi from the west, and the interruption of the southward flow of the Ganges also contributed to divert the water eastward. There is also evidence of some "rising" of the land in the south-west as there is clear proof of subsidence to the south-east from the interminable stretch of basins or *bils* from the east of Calcutta to Bakarganj. Geologists suggest that the eastward swing of the Ganges was probably in obedience to some sinking in the south-eastern quadrant of the joint delta, which countered all the natural rotational deflection westward, and set the confluence practically as far south as the tropic and as far east as the 90° E. meridian. They point out that the 200-fathom contour, which runs almost due north-and-south—possibly associated with the seismic lines of Assam—comes within 30 miles of the Sundarbans coast here; and it is only there 400 miles from the 28,000 odd feet of Kanchanjangha.¹ In Northern Bengal in the 16th century the Padma was flowing much more towards the north curving through the Rajshahi and Pabna districts. In Akbar's distribution of pargannas Bazurash, Bajuchappa and Nejrathshahi, which were parganas of the north, were included in the Sarkar of Mahmudpur-Murshidabad. "A chain of rivers and *bils* can be traced along what seems to have been the Sarkar boundary," writes the Settlement Officer of Pabna and Bogra. This seems, according to him, to have followed the Padma as far as Sarda and struck inland to the line of Chiknai; a stream always navigable for country boats and to the Atrai, which flowing south-eastwards rejoined the Pabna. In Rennell's time the Padma was curving even

¹ Lyde: *The Continent of Asia*, p. 417.

farther north and it was then considered probable that the river might force its way along the channel of Baral. Further to the east, the D'haleswari from Jaffergunge probably represented the old course of the Ganges to Dacca (if the Ganges ever flowed past Dacca), which flowed thence south-east to the Meghna. The Sabhar inscription, which Dineshchandra Sen places in the fourteenth century, shows the Ganges as flowing below Bhawal or Bhabalina. Bhattasali observes in this connection: "This statement furnishes proof of the current tradition that the Ganges used to flow in olden times through the D'haleswari channel, or even further north along the course of the present Burhi Ganga." The Pragjyotish at that time seemed to have extended up to the confluence of the Lohitya and Brahmaputra. The Burhi Ganga was, indeed, described by Manrique as the famous Ganges. The D'haleswari and the Padma in some portions of their channels were identical. Manickganj was formerly on the west of the Padma and the district of Faridpur touched Munshiganj. Traversing the district of Faridpur the Padma met the Meghna at Kandarpapur in the district of Bakarganj. Moinakata and Arialkhan represent the remains of this ancient channel. Dacca, situated on the banks of the Burhi Ganga that is indicated as a large navigable river in Van den Broucke's map, rose to be an important trade centre and became the royal capital in 1608.

How Rivers shift and decay. Before we discuss the effects of the constant changes of the courses of rivers in the delta, let us pause for a moment to consider the causes of such divagations. Fergusson, in a very interesting account of the recent changes in the Gangetic delta,¹ points out that one great peculiarity of the deltaic rivers is that they oscillate in curves, the extent of which is directly proportional to the quantity of water flowing down the channel. Owing

¹ Journal of the Geological Society of London, Vol. XIX.

to this oscillatory movement the current strikes alternately on its right and left banks, and as a practical consequence there is found on one side of the river an almost perpendicular bank more or less elevated above the stream, according to the season, and with deep water near it, and on the opposite side a bank shelving away so gradually as to occasion shallow water at some distance from the margin ; evidence of successive operations of this kind is observed in going up or down the river. At every point where the current strikes the bank the river tends to force its way through it ; and, should the current be sufficiently strong to force itself through the opposite bank, and should the land beyond the bank have a greater slope than the bed of the existing channel, a new channel is sure to be formed. The condition as regards the slope of the land, though not the immediate, is the most important cause of the shifting of river-channels in the deltas, and is fulfilled in the following manner.

The silt borne by a river, which owing to its passage through a comparatively level tract of country has turned from an excavating into a depositing agent, is accumulated partly on the sides, thus gradually embanking the river, and partly on its bed. These two processes go on simultaneously until the banks have been raised above the inundation level, when almost the whole of the silt that is not carried to the sea is laid on the bed of the river, which is gradually elevated, becoming eventually higher than the low land beyond the raised banks of the river. The river then falls into this low land, and, going through the same process, fills that depression and proceeds to the next ; after a long cycle of years returning to the country it at first left. In passing through a country which has thus been abandoned by a river, we meet with a succession of raised levels marking the positions the river banks occupied at different times, and the land between them sloping in the direction opposite to that which the river took in shifting

its course. As a result of the continuous process of silt deposition both in the river channel and on either bank of it continued indefinitely, the margins rise so high that they virtually become low flood banks of the river and enable it to retain water even when the bed has risen higher than the marginal plains. When, therefore, on account of erosion in a curve or other reasons such as abnormal high floods, breaches in these flood banks occur, slopes away from the river being available, a new branch gets formed, or sometimes the whole river deviates into a new course through the breach. In the one case, therefore, the reach of the river below the breach begins to deteriorate. Further if better slopes and more friable soil are available, the new branch gradually develops, and eventually induces the whole river to divert itself into it, while the old course languishes. In the other case this event follows the change immediately. Similar phenomena occur on the branches of the river resulting in minor or smaller dead rivers. Periodical oscillations of the main river channel between its permanent banks also affect the regime of the off-taking branches. Those taking off from the bank being hugged by the deep channel for the time being improve, while those taking off from the other bank assume a moribund condition. Earthquakes also by sudden upheaval of some and depression of other tracts of a country cause changes in the courses of rivers resulting in deterioration of some and improvement of others. Dead and dying or old rivers are thus a natural feature of a deltaic region.¹

Shifting Rivers and the Works of Man. The rivers begin the work of land-formation and man completes it. Such was man's first settlement on the tracts that are

¹ I have availed myself freely of a recent description by Man Singh, Executive Engineer of Bengal; *vide* also Jack : Settlement Report of Bakarganj.

covered by the older alluvium. These first-settled tracts have now become more or less high land, interspersed with ridges, and the rivers here are hill-torrents subject to sudden floods of rain ; they never inundate the country for any length of time. Thus the older land does not possess the extraordinary fertility of the newer deposits. Winter rice here can be cultivated successfully only in the depressions and drainage hollows ; in the uplands embankments, ridges, tanks as well as reservoirs, are necessary for the cultivation of rice. The farm practices and methods of irrigation in Gaya, Monghyr, Birbhum, Midnapore and Burdwan are alike. The uplands are used chiefly for spring crops, while in the lowlands elaborate methods of irrigation are resorted to for the success of rice cultivation. It is also not at all extraordinary that in the heart of the immature delta, where we have outcrops of the old alluvium the farming methods and practices of Old Bengal are perpetuated. In Dacca district the transplanted paddy is grown on two different classes of land. The constant fluctuations of the river-beds and river-banks cannot fail to affect the population ; and, indeed, the mightier the rivers and the greater their changes of course, the more profound the effect on humanity. There is hardly any district in Bengal which is not strewn with old river-beds, and which has not its deserted cities and forgotten kingdoms. Each such old river-bed is but a representative of countless others obliterated by nature or man ; each signifies a dislocation of human settlement. Now the sand-banks and mounds whisper a tragedy of abandonment, flood or disease. Saptagram, Karnasuvarna, Tamralipta, Bhurishreshti, Kankagram and Mahasthan, all now marked by small mounds ; Gaur, once a city on whose roofs one could walk miles in any direction, now obliterated by dense forest ; Tanda, once the ancient Mussalman capital of Bengal, but now overgrown with jungle ; Tribeni, once a famous commercial emporium, now a mere bathing ghat ;

Nadia, the old capital of the Sena kings, swept away by a sudden change in the course of the Bhagirathi in the beginning of the nineteenth century ; Sonargaon on the Meghna, the medieval Mussalman capital of Bengal and a great port, reduced to village dimensions at the time of Akbar ;¹ Murshidabad, the last capital of the Nawabs of Bengal, and Cossimbazar, the busy silk town and health resort of the East India Company, both now malaria-stricken villages,—all testify to the ruthless vagaries of the rivers. The Padma in particular has been a great destroyer ; and, in one portion of the channel is called the Kirtinasa, because of the sport it made of Sripur, the far-famed capital of Kedar Roy, one of the last independent rulers of Bengal and the hero of a hundred naval battles. Political power, industry and trade have shifted in the history of Bengal with the constant changes that the river-courses have undergone and are undergoing in a delta yet in the making, like that of Lower Bengal. Not less far-reaching have been the effects on settlement and cultivation.

Reclamation Work on New Land. Agriculture is difficult in the older alluvium and easy in the new. Whilst the rivers advance, ever capturing more fresh land from the sea, man follows in their wake and successfully takes up the work of land-reclamation. Civilisation, therefore, is carried onward by the current of the land-forming rivers. The greater fertility of the new alluvium brought down by the new active rivers leads to an enormous multiplication of population along their banks ; thus civilisation is kept always on the move. The upper and western portions of the delta in the meantime become moribund when the rivers that built it deteriorate or die. Both fertility and population diminish in the inactive delta, but a new prosperity emerges in the eastern tracts, which a few decades back

¹ Fitch (1586), however, calls it a town.

were covered with dense forests, and honeycombed with swamps and lagoons, now gradually filled up by the active rivers. The transformation is effected by a process which is somewhat as follows. There is very little high land in the region occupied by the new alluvium, the only elevated parts being narrow ridges on the banks of the larger rivers. Such ridges are due to the stupendous amount of silt carried by the river ; sometimes they are sandy and in a state of constant flux, hardly allowing man to obtain a foot-hold. But often these ridges are stable and fertile. At first they are used as pasture grounds, but gradually agriculture and settlement become permanent, according to the age and fertility of the new deposits. Belts of trees grow along the banks and stabilise the settlement ; the interior of the plain becomes gradually studded with villages, built on artificial mounds of earth raised above the height of the inundation. These little islands vary in extent ; some of them affording room for huts of two or three families of cultivators with their cattle, while others are of considerable size, sufficient for entire villages and their gardens. In the lower delta there are no village sites. Each hamlet consists of four to six houses (each housing a family) ; these are built of mat and thatch on a high plinth, composed of earth thrown up from the surrounding moat, and enclosed by a wall of palms, bamboos, areca nuts and *mandar*. Such hamlets cluster usually along the banks of the smaller streams, so that there may be less danger from inundation. Even the tanks have to be enbanked in order to keep out the surface water and inundation. From such settlements the land gradually slopes inwards, often meeting a similar incline from some other river ; and chains of basin-shaped marshes, frequently of great extent, are thus formed. The entire tract is traversed by numerous streams and offshoots of the rivers, and by marshes and *jhils*, and

is subject to annual inundations which leave a top-dressing of inexhaustible fertility. Thus the land of the active delta may be classified as follows :—

(1) The *chars* of the oldest formation present much the same appearance as the mainland and often would show a higher level than the latter ; there are villages consisting of little groups of houses surrounded by *mandar* trees and palms, with intervening stretches of rice-field. The varieties of rice grown here are usually *aus* and transplanted *aman* under conditions of flush alternating with flood, when it does not exceed a height of, say, $2\frac{1}{2}$ feet in the flood season.

(2) The newer *chars* are marked by the absence of trees, and consist generally of a uniform cultivated plain intersected with numerous *k̐hals*, with here and there bare patches where the soil is unfit for cultivation. *Aman*, sown broadcast or transplanted, is usually grown in these formations.

(3) Yet younger formations are the banks barely above water, but covered with grass, on which herds of buffaloes may be seen grazing. In the immature *chars* of a large number of active rivers in the lower delta, there is a luxuriant growth of grass which is used for fodder and thatching. It is the abundant growth of grasses which collects mud and sand during the flood-season, and thus contributes to raising the level of the land for human settlement. Gradually vegetables, such as water-melons, *k̐hira*, cucumber, etc., are grown in succession. *Boro* rice is grown in *chars* and swamps where the flood is too deep for *aman* during the flood season, and which become too hard and dry for *aus* and jute during spring.

(4) Youngest of all are the banks of mud and sand emerging from the river only when the tide is low, and still of no value but to the fishermen. All along among

these *chars* and islands may be seen traces of constant change, upright or overhanging banks where the river is cutting away the dry land, gently sloping banks where new land is forming.¹ Where the older formations abut on the river, the banks are cultivated ; where newly formed soil exists, the banks are either uncultivated, used as pasture ground or cultivated according to the age and fertility of the new deposit. The soil of the newer *chars* requires little preparation. Cows are used as well as bullocks for ploughing, and on the *chars* buffaloes are employed. It is estimated that three pairs of bullocks can plough an acre in six hours ; that a pair of oxen would suffice for cultivation of a plough of land equal to 5 or 6 acres, and that a pair of buffaloes could manage nearly twice that area.

Scour, Irrigation and Cultivation in Lowlands. In alluvial formations, owing to the excess of deposit on the edges, the water flows inwards from an elevated surrounding and enclosing ridge to a central basin, whence it is conducted to the exterior, along watercourses piercing through the surrounding ridge. This order is followed not merely in tidal districts like Bakarganj, but in all alluvial formations, however elevated, as, for example, in Sylhet or in lower Bengal.² Each of the drainage circles or districts possesses its central basin or reservoir of swamp, towards which the surface slopes in every direction from the exterior. On the exterior edge of the area where it abuts on the large sweet water or tidal river (which everywhere divides one drainage circle from another), the land is well raised and covered with villages. The intermediate space is occupied by rice cultivation, and the centre is a lake or *bil*, varying in size and depth with the season of the year. It is

¹ Webster: *District Gazeteer, Noakhali*, p. 3. *Statistical Account of Bengal, Noakhali*.

² Pellew's article in the *Calcutta Review* (Vol. XXXIX, No. 78), reproduced in Beveridge: *District of Bakarganj*.

thus in all deltaic tracts the level of the land in the interior is lower than that bordering on the main rivers, which are connected with *bils* or drainage reservoirs at a distance by the numerous small watercourses, ramifying along successive terraces of rice-fields. During the rainy season, all the interior articulations of the system of relieving channels are submerged. Only the larger and more external have their banks above the water; the smaller feeders are supplied both from their extremities and over their own banks. The greater volume of water which then requires passage is thus amply provided for; while in the dry weather when the drainage volume is weak, the water is unable on account of the fall in its level to leave the reservoir except through the extreme ends of very small channels. The banks of the different classes or grades of channels, each in turn begins to fulfil its proper functions, as the level decreases, and in this manner the waterway is always exactly proportioned to the volume to which it is required to give passage. In districts of alluvium raised above tidal influence the rise and fall of the rivers during the rainy season produce similar effects. The water in the swamps being only connected with these by narrow channels piercing the banks of the rivers is always, unless the river remains very long at exactly the same level, either above or below that level, and the channels are incessantly occupied in restoring the balance. The agricultural practices of the Bengal delta are intimately connected with the submergence and drainage of the country at its different levels by the inundating and scouring waters, which maintain connection with the central basin through a branch system of terminations. Swamps, *khals*, channels and rivers, all play their part in the incessant movement of considerable volumes of water, which has sculptured the deltaic landscape and evolved its appropriate cropping and agricultural practice.

Rice Culture on New Land. The older alluvium on the banks of the rivers is usually a coarse light sand, on which jute and *aus* paddy are successfully and extensively grown. Throughout the new delta, *aus* is sown broadcast on the comparatively high and sandy *diara* lands. The *aus* paddy grows to a length of three to four feet only, and cannot be grown on lands on which more than two feet of water accumulates during the early monsoon rains; it does not keep pace with the rise of the water, as does *aman*. The soil on the margin of the *jhils* is often a stiff black clay, well-suited to the long-stemmed rice, which lives and thrives under several feet of flood water. All low-lands, sides of the marshes and low plains in the delta, on which from five to fifteen feet of water accumulates during the rains, are selected for the *aman* crop. The *aman* has a remarkable power of growth, frequently shooting up to the extent of one foot in the course of a single day as the flood water rises, and, in the case of some varieties, such as *rayenda* and *baoa*, attaining a length from 10 to 20 feet. Crops and farming practices are adapted to the changeable character of the land and the soil. In the shifting *chars*, which rise and disappear within a few months, quick-growing varieties of *boro* paddy which require little human attention are grown. On some of the islands of the Padma large areas of land are sometimes to be seen almost level with water at a low tide, covered with mud so soft and so deep that there is great danger of one going there being buried alive. The peasant here has discovered a method of growing *boro* paddy on it known as the *lepi*. No ploughing, harrowing or anything of the kind is needed, nor is it possible on such lands. All that is necessary is to sow the seeds broadcast and plaster (*lepa*) the mud over it. This is not, however, an easy task owing to the unstable nature of the ground. The peasant who sows has to support himself on a plantain-tree or a raft of bamboo. The land

is flooded at every tide, but that does not injure the seed on account of the protection afforded by the mud plastered over it.¹ In the Meghna *chars* as well *boro* is sown broadcast when the *chars* are uncovered in April, and remains a moist mud until the waters rise again. The rice grows very quickly, as it must if it is to be reaped in the *chars* before the heavy floods. As stated, it is capable of growing as much as six inches in a day, and in the *bils*, the stem is extraordinarily long, sometimes 15 and even 20 feet. The crop is, however, very precarious, since a very sudden rise will completely destroy it. In more sandy areas grasses such as *kaun* or *karcha* are at first grown with the intention of assisting the clayey matter; sweet potatoes can be grown with success at an early stage, but it is only after several years of cultivation that a crop of jute or *aman* can be grown with success.¹ In some areas in Bakarganj the cultivators grow an early rice called *shatiya*, because it is said to remain in the fields for 60 days. The land is ploughed and reploughed quickly five or six times, and the seeds are sown broadcast. The changes of nature are rapid, and man must adapt himself to them. Instances are not uncommon of the same *char* being twice washed away and twice reformed and inhabited within the space of twenty years. In this adventurous manner man has lived and thriven on the mighty rivers which form the main source at once of his water supply, his main means of drainage and irrigation; and his health and crops suffer when the river flood is low. We read in the *Dacca Survey and Settlement Report*:² "The land depends for its fertility on the

¹ For a description of agricultural methods and practices in the delta, see A. C. Sen's *Report on the System of Agriculture and Agricultural Statistics of the Dacca District*, of which I have availed myself freely in this chapter. See also Jack: *Bakarganj Final Settlement Report*.

² Ascoli: *Final Settlement Report of Dacca*, p. 15.

deposit of silt by the flood, the crops depend for nourishment on the waters of the flood. A low flood will accordingly fail to fertilise and irrigate the high lands; a normal flood will bring water and leave silt behind it; an excessive flood will drown or sweep away the crops; and instead of depositing silt will scour away the earth; silt is deposited more by slow than by fast-moving water.' Further, when the flood is low, there is no flush or drainage of the higher lands, and stagnant water accumulates in pools, causing malaria and epidemics of cholera and small-pox in the deltaic tract.

Amphibious Life in the Delta. The change from a less advanced to a mature stage of formation of alluvium also governs largely the crops and methods of cultivation. In tracts where the delta formation has sufficiently advanced a stiff clay ultimately supersedes a more or less coarse sand. This change is very gradual and slow, but it ultimately affects the cropping. *Aus* paddy supersedes *aman*, and such crops of the upland as cotton, oil seeds, *gram* and pulses become more and more important. A long period of settlement also leads to the localisation of village industries and workshops, and permanent markets usually arise on the banks of rivers which have ceased to wander. But fortune at best is precarious in a deltaic tract. Industries and markets have to go elsewhere, when the rivers seek new channels. This is why the delta is full of vestiges of abandoned market-places. When the creeks become too shallow for navigation, fleets of bazar-going boats come and go with the rise and fall of the tide and create a brief animated scene in a backwater. In other parts the people go off for a whole day in their long dug-outs or canoes, which every family must possess for the purchase of daily needs, to a distant *hat* or market which periodically assembles. Probably a dozen markets will be within boating distance, giving the villages an opportunity to compare prices. Such journeys

are not without their risks, but the people take to the water like fishes. In the new delta, the rivers, creeks and other watercourses are the highways, and boats are by far the most important conveyances. The boats used for goods or passenger traffic are of considerable size, and there are various types and forms, adapted to the needs of navigation on the various rivers. The boats which the cultivator's family possesses are of the smallest size, without any cover or fixed helm. Such boats are used mostly during the rains to bring fodder for the cattle and harvested paddy from the fields, or in going to the markets or for friendly visits. The poorer classes of cultivators make use of rafts made of plantain trees and earthen tubs. Roads are few and short ; indeed, these, especially when bridged, are not of much use in the delta, and sometimes prove detrimental to country boat traffic. In the district of Bakarganj, with an area of 2,427 square miles, there are now only 337 miles of road. Canals and artificial watercourses are more useful in the rural economy of the delta, and new creeks used to be excavated by kings and *zamindars* to save distance for boat communication, or to avoid dangerous journeys across the larger rivers. Jack graphically describes the risks of a journey in this part of the world :—

“ High winds range for weeks together so that light craft cannot venture upon the big rivers ; yet for a journey on foot, you must needs be at once an amphibian and a monkey, prepared at every quarter-mile to wade a shallow stream or swim a deep one, to balance giddily on a bamboo bridge where a false step means a bath in mud, and finally to reach a wide river and to wait, it may be for hours, until the reluctant boatman of a passing boat consents to ferry you across.”

In a year of normal flood the cultivators need not reap the winter crop in water, since the *aus* fields are high and dry ; but jute must be reaped from under waist- or breast-deep water and from boats. Sometimes when the flood is high

and heavy, the most assiduous toil of the peasant, working day and night under water, cannot save the harvest. Thus economic life is most uncertain. All the labour and capital invested in homesteads and plots often go for nothing when the treacherous river cuts the bank and swallows up the settlement. A homestead in the delta is, therefore, seldom permanent for two or three generations on the banks of the larger rivers. Houses are seldom built of brick and stone, as in the upper delta, but are corrugated iron or tin sheds, which can be easily removed in boats for settlement elsewhere when the river threatens life and property. On the other hand, while the rivers often devour villages and cultivated fields, they sometimes bestow a fortune unawares by throwing up new sand-banks adjoining one's plots and homesteads, and so what requires generations to build comes as a gift from heaven within a few short years. But then arises litigation among superior or inferior landlords and tenants. Indeed, whenever sand-banks or small islands are thrown up in the midst of the stream, or near one of the banks, there are contending claimants who assert their rights and take possession of such lands in an incredibly short time—a practice sometimes leading to serious breaches of the peace. Life under these conditions is full of strange happenings; it has its under-currents, tides and whirlpools like those of a river, bearing man as a wisp of straw he knows not whither.

Dead Seaports of the Delta : Tamralipti through the Centuries. Not merely agriculture and the general social and rural life of the people, but likewise the movements of trade and commerce are stamped with the delta-building activities of the rivers. The Ganges estuary has had a chequered history, with which is connected the rise and decline of the seaports of Bengal. About the time of the Buddha, and possibly earlier, sea-going vessels used to be laden with the merchandise of the Ganges plain from

Benares. The next important commercial emporium was Pataliputra, situated at the confluence of the Ganges and the Son (Hiranyavaha, Gk. Eranboas), which rose into importance under the Mauryas. During this period another important port was Champa (modern Champaknagar, 24 miles east of Bhagalpur). From this port passengers used to depart for Suvarnabhumi (Burma), and for Taprobane (Ceylon). Then arose Tamralipti (modern Tamluk), which is mentioned in the Mahabharata, Vrihat Samhita and the Ceylonese Buddhist chronicle, the Mahavamsa. In the *Periplus of the Erythræan Sea* (1st century A.D.) there is a reference to a port on the mouth of the river in Bengal; very probably this is Tamralipti. Tamralipti was the capital of ancient Suhma in the 8th century of the Christian era, and formed a part of the Magadha Kingdom under the Mauryas. In 410 A.D. Tamluk was still an important seaport, and was referred to as such by the Chinese traveller, Fa Hien. But within the next two centuries the doom of this world-famous port, which throughout carried on a brisk trade with ancient Rome and the Mediterranean countries, was sealed. For in the seventh century A.D. another Chinese traveller I-tsing, describes it as on an inlet of the sea. Thus the process of land formation, which has resulted in Tamluk, once situated on the sea-shore (velakulam), now being 50 miles from the sea, had begun. By the 10th century, the channel on which Tamluk was situated, and which afforded facilities of navigation, was silted up. Tamluk still continued, however, to be an emporium of commerce until the 16th century. For well-nigh two thousand years this far-famed port of the east was visited by foreign merchants from China to the Mediterranean; here lay in anchor hundreds of Bengal ships, which carried to distant shores the merchandise, culture, religion and art of Bengal through the epochs. With the gradual decline of its importance,

Hijli came into prominence. The Portuguese settlement in Hijli (1518¹), on the west bank of the Hughli river at the mouth of the Rasulpur river, seems to have been the earliest European settlement in Bengal. Ships used to anchor from Negapatam, Sumatra, Malacca, etc., and cargoes were landed here for transport up the Hughli. Hijli is now a littoral tract extending from the mouth of the Rupnarain along the western side of the Hughli estuary, and forming part of the Midnapore district.¹ A large part of South-western Bengal, bounded by the Adi-Ganga on the east, continued to be described as Tamluk until the middle of the seventeenth century.²

The Ancient Course of the Bhagirathi and its Main Channels. In most ancient times the Bhagirathi flowed through Suhma. "The Ganges passed through the country of the Tamraliptak," we read in the Vayupurana. The Tamraliptak is probably Suhma, and the Bhagirathi traversed it through different channels in different epochs. One such channel is the Kandar channel running parallel to the course of the Bhagirathi in Kandi subdivision (Murshidabad), the eastern part of which is now intersected with meres, pools and river-beds. The extensive swamps, known as the *Hijal* and *Patan bils*, which Chand Sadagar traversed after passing Nava Durga-Golahat, appear to be old beds of the Bhagirathi; while the Ajay, which was also an important channel of the Bhagirathi, flowed through the bed of the Kanur in the Katwa subdivision. Both the Bhagirathi and the Ajay have now moved much further away. A thousand years ago the Ajay-Bhagirathi doab was known as Kankagram, the city of that name being then situated on the Bhagirathi, and identified by Nagendra-nath Vasu with Ka-gram, a village in Kandi subdivision.

¹ Campos: *History of the Portuguese in Bengal*, p. 94.

² Vide Jagmohan Pundit's *Desabali Bibriti*, a book on geography composed in Sanskrit in 1643.

The Chinese traveller's Kajangala is probably the same as Kankagram, while the monasteries and temples described by him probably lie buried in the area between Panchthupi and Salar. Rangamati, Goysabad and Mahipal are all full of ancient Buddhist images and mounds. The Damodar was an even more important tributary of the Bhagirathi. Its ancient course is described in the Behula literature, which has spoken of myriad ports now in oblivion. The wanderings of this river are largely responsible for the ups and downs of Rarh. On this river stood the famous cities of Bhuri-Sreshthi in the past (Bhursut in Arambagh subdivision) and Mahanada (four miles south of Pandua). It was through the channel of the Damodar or its branch, breaking off from Champanagari of Manasamangal fame, that the merchants of Bengal reached the port of Tamralipti in Samatata.¹ Van den Broucke's map showed the Dwarakeswar, a branch of the Damodar river, as joining the Rupnarain, called the Ganga by some foreigners, at Nursipour, and proceeding to the sea. Rennell's map also shows that the Damodar sent one of its branches to the Bhagirathi above Tribeni and another branch joined the Saraswati at Nursipour. It appears from recent surveys that one of the main lines of entry into Bengal in the past was up the Rasulpur river, thence by a channel connecting it with the present Haldi river, and across by a branch of the Rupnarain, which flowed direct into that river. From the Rupnarain there was another channel going direct into the Hughli some distance above Calcutta. It is clear from the maps of the 18th century that the Rupnarain was more important formerly than now, and that it had two channels, one the

¹ Some valuable articles on the geography of ancient Bengal are to be found in the *Sahitya Parisad Patrika* (1339, 1340, 1341) from the pens of Nalini Kanta Bhattasali, Jogesh Chandra Ray, Nagendra-nath Vasu and Kalidas Datta.

existing channel into the Hughli, and the other, which branched off below Tamruk, into the Haldi. Thus the thanas of Maishadal and Sutahata were formerly an island. In maps older than Rennell's, the peninsula between the Hughli and Rasulpur rivers, now thana Khejri, is shown as an island. The Maps of De Barros (1550) and Blaeu (1650) show Hijli as an island. In Van den Broucke's map the channel is not shown, having been nearly silted up. It is the first map to name Tamboli. In a map of the Province of Midnapore, now in the Imperial Library, Calcutta (dated 1760), the channel is called Tommluck Colly, and there is also shown an inner silted-up channel, called Garcay Colly. In Rennell's map the channel is shown as Tingercolly river.¹ In the map of India by the Jesuit Missionary Monserrate (1590) we find the following places inserted in the Bengal portion :²

das Palmeyras or P. Palmiras
 Galloru Insula or Cock's Island.
 Chandecan
 Ragore or Radg-Gur on the Rupnarain
 Bethor or Bator (Sanskrit Betadda), now a thana in
 Howrah town
 Goli or Hooghly
 Satagam or Saptagram
 Tanda

The references to Bator and Ragore are rather significant.

It is clear therefore that the march of the greater rivers towards the eastern portion of the delta began about one thousand years ago. The decline of the tidal rivers

¹ M. M. Chakravarti : Notes on the Geography of Old Bengal, J.A.S.B., May, 1908.

² This map is reproduced by Hosten : *Memoirs of the Asiatic Society of Bengal*, Vol. III, 9, 1914.

Rupnarain, Haldi and Rasulpur took centuries, but this ultimately brought about the downfall of Tamralipti. After the decline of Tamralipti, several important seaports came into prominence in Western Bengal. Samatata and Harikela are mentioned by the Chinese travellers, and we also find the mention of Bangala by an Italian traveller, Barthema (1505 A.D.), and a Portuguese traveller, Barbosa (1514 A.D.). Samatata is probably the tract of the new delta where Bakarganj now exists. It is probable that Harikela and Bangala were situated in the western bend of the estuary, and that their sites have been destroyed by new land formation. Bangala is described as a large and beautiful port inhabited by the Moors, and situated just at the entrance of the estuary. Some identify Bangala with Bakla.¹

The Ancient Importance of the Saraswati: Saptagram through the Centuries. Further inland Saptagram on the confluence of the Saraswati and Bhagirathi, which was more accessible to the larger ships, maintained its eminence for several centuries as the most famous port of Eastern India.² Indeed, the celebrity of Saptagram goes back to the 1st or 2nd century of the Christian era, when it was the capital of Rarh, by whose eastern boundary the Ganges flowed. It was called Gange by Ptolemy, and was described in the Periplus as the 'Port of Ganges,' the sea being then much closer to Saptagram than it was in later centuries. Even in the 15th and 16th centuries large vessels sailed up the Saraswati. Merchants from various parts of India, as Kalinga, Trailanga,

¹ J. N. Das Gupta, however, thinks that Bangala occupied a position between the Hatia and Sandwip islands, situated at the present mouth of the Brahmaputra (see his *Bengal in the 16th Century*, p. 120); while Taylor and Stapleton identify the town with Bangala-Bazar and other places in the present city of Dacca.

² See R. D. Banerjee : Saptagram or Satgauw, J.A.S.B., July, 1919; N. L. Dey : *Geographical Dictionary of Ancient and Medieval India*, p. 178; *Hooghly District Gazetteer*, pp. 304-309.

Gujrat, etc., used to come to Saptagram for trade, and it was from here that muslins, spices and other goods were exported. In 1585 Ralph Fitch found Saptagram "a faire citie for a citie of the Moores, and very plentifull of all things." But within the next two decades this city was to perish.

When Rennell drew his map (1764), the Saraswati was "a small creek," being only 7 ft. 6 in. deep at high water near its exit from the Bhagirathi. His assumption that Saraswati once passed through the site of Bellya morass to Omph (Amta) on the Damodar and then crossed to the Rupnarain to march to the sea is unacceptable. The old course of the Saraswati, through which the Ganges waters flowed after the Bhairab course lost its importance, probably in the 12th century, seems to be that by Syannegger (Shahnagar), Chaumaha, Bejjeh Sundari, Amgachi and the Belya morass, whence it took an easterly course to return to the Bhagirathi at Betalda or Bator. This is the course of the Saraswati, as charted by De Barros and Van den Broucke. After Bator the Saraswati occupied what is now the old bed of the Bhagirathi to flow seaward through Pichalda.

In the 14th and 15th centuries the trade of Saptagram or Satgaon, suffered an eclipse. Gaur, the royal capital of the independent Sultanate of Bengal, had already been a magnificent city,¹ five or six centuries before Christ, but she rose into her greatest opulence in the 14th and 15th centuries. It was situated not far east of Rajmahal where the Ganges entered Bengal. Unlike most of the other dead cities of Bengal, which occupied sites on elevated red alluvium, Gaur, as Stapleton observes, had been established by embanking an island of the Ganges. The oldest settlement

¹ Gaur had a population probably of over a million. See Monahan : *Early History of Bengal*, p. 237.

of Gaur, however, was on the banks of the Kalindri river ; the city gradually extending southward by the construction of embankments. Ten or fifteen miles to the north-east was Pandua, which served for many years as the alternative capital of Bengal, and the spiritual centre of the Muhammadans. The Meghna was then the principal route to the capital of Bengal, the other being up the Bhagirathi. Chittagong, situated at the mouth of the Meghna, was then Bengal's chief port, and was named by the Portuguese Porto Grande (grand port), in contradistinction to their Porto Pequeno (small port) in Satgaon.¹ Other important ports on the Meghna were Bakla, Sonargaon and Sripur. Fitch (1585) visited all these ports together with Tanda, Hughli, Saptagram and Chittagong. From Sripur, he sailed for Pegu, "passing down Ganges and passing by the island of Sundiva." Sundiva is Sandwip. Sonargaon is now situated away from the banks, 15 miles east of Dacca. This was the ancient Muhammadan capital of Bengal. Sonargaon flourished as the seat of the Muhammadan governors of East Bengal from 1296 to 1608, and was famous for its cloths and muslins. The capital was removed to Dacca in 1608 on account of the raids of the Ahoms, the Arakanese and the Portuguese pirates. Gaur was reduced by the Ganges receding westwards, leaving long shallow marshes behind it. Fever followed and depopulated the city, the final epidemic of 1575 being so terrible that the dead could be neither buried nor burnt; whereupon the few survivors fled from the place. The site was before long covered with jungle infested by tigers. Within half a century the

¹ Moreland thinks that the Porto Pequeno refers to the estuary of the Hughli, and the Porto Grande to the estuary of the Meghna, which extended from the Karnaphuli river to the immediate neighbourhood of Dacca.

The Porto Grande is located in Tippera District according to Fitch.

population of 200,000 described by the Portuguese travellers had disappeared.¹ With the decline of Gaur, Chittagong lost status as a seaport, and trade was again diverted to Saptagram, or Satgaon, then situated on the Saraswati, near the place where it branched off from the Bhagirathi below Tribeni. The Saraswati joined the Bhagirathi lower down near Bator. Bator or Betadda was a famous mart, which gave its name to a subdivision of Bardhamana-bhukti (Betadda-chaturaka). A thriving port-town visited by the European merchants for centuries now has been reduced to a small village about a mile from Sibpur in Howrah district.

Two Western Channels to the Bay until the 16th Century : The Saraswati and the Adi-Ganga. The main current of the Ganges till the middle of the 16th century, streamed through the Saraswati.² In its upper reaches the Saraswati is clearly traceable now in the rains at Chandernagore and Chandidola, while in its lower reaches it is a small tidal watercourse, entering the Hughly at the lower end of Garden Reach at Sankrail. The Saraswati received a branch of the old Damodar river near Nursipour, and once vigorously flowed through Howrah, Midnapur and 24-Parganas to the Bay, and its course is often now mistaken for that of the Hooghly. Formerly a narrow channel also branched off from the Bhagirathi near modern Kidderpore, and met the Saraswati at Sankrail. A well-established tradition says that in the reign of Nawab Ali Vardi Khan the Dutch merchants diverted the waters of the Bhagirathi to this channel for the facilities of navigation.³

¹ De Barros, quoted by O'Malley, *Bengal Census Report*, 1911, p. 25.

² Campos : *History of the Portuguese in Bengal*, pp. 21-22.

³ A factory, residential quarter, and garden, all claimed to be of Dutch origin, are to be found in the present Royal Botanical Garden.

The original channel of the Bhagirathi itself can still be identified with the Tolly's Nalla or Surman's Nalla (Rennell) or the Adi-Ganga at Kalighat; from opposite Bator, it took a south-eastern direction and coursed through the towns of Kalighat, Gobindapur, Garia, Baruipur, Sasan, Nachangacha, Jaynagar, Rajpur, Chhatrabhoga, Multi and Hansghar, some of which have now become insignificant villages. The Bhagirathi thus occupied the beds of the Ganga Nullah, Gobadya Gang, Ghebattee Gang and Muri Ganga or Baratola river, which now flows into the Bay east of Dhoblat. Formerly the river went in a southerly direction from Dhoblat to join the Bay at Ganga Sagar. Up to Jaynagar the old channel is known variously as the Adi-Ganga, Burha Ganga and Ganga Nullah. It long ago dried up, but is clearly discernible at various places, such as Baruipur, Dakshin Barasat and Rajpur in the Sadar subdivision, and Multi and Hansghar in the Diamond Harbour subdivision of the 24-Parganas. "Even in places where it is entirely silted up, tradition points to old tanks still called Ganga, as having been excavated along its course, while it was an active stream. Such tanks may be found at Jaynagar and Vishnupur and Khari in the Mathurapur thana : that at the place last named has a special sanctity and is known as Chakratirtha or Chakraghata." ¹

According to the description of the *Khulasat*, one part of the Ganges flows east and is known by the name of the Padma(bati), while the other, turning south, branches off into the channels, of which the first is called Saraswati, the second Jumna and the third Ganga. This third with its thousand branches joins the ocean below the port of Satgaon. It is interesting to note that this 17th century description of the mouths of the Ganges tallies in main

¹ *District Gazetteer of the 24-Parganas*, p 8.

features with that given by Ptolemy, by Abul Fazl and, finally, in the Chaitanya Bhagavata.¹ At the time of Chaitanya, the Bhagirathi split up into innumerable branches much below Saptagram at Chhatrabhoga, and was called the Satamukhi Ganga. The Jamuna, which was a considerable river at the period when the whole stream of the Ganges swept by Tribeni, and along with the Saraswati formed the Dakhin Prayag, has now become a moribund channel of the Ganges.² Its upper reaches are now hardly traceable. In Rennell's maps the name Jabunah persists from the Hughli river to Savashpour on the Isamot (the Ichhamati) river. It left the Bhagirathi at Kanchra Para and fell into the Ichhamati near Mullickpur. Even in Rennell's days the river in the wet season was "deep enough for the largest boat." Fulfilling a pestilential role in the south of Hughli and Jessore districts the Jamuna passes through the western portion of Khulna. It was formerly met by the Ichhamati in the north-east of the present Basirhat subdivision, whence the combined streams flowed southwards to the Bay.

Cities and Ghats, Old and New, on the Saraswati and the Adi-Ganga. By the 16th century, however, the Bhagirathi diverted its current through the main channel, and caused the silting up of the Saraswati to so great an extent that the sea-going vessels had to anchor, according to the Venetian traveller Caesar Federici (1578 A.D.), at Bator, several miles down the river from Saptagram.³ A temporary market sprang up in this place every year, when the outgoing

¹ See Ptolemy's *Geography*, p. 100; also Willford in *Asiatic Researches*, Vol. XIV, pp. 464-66.

² See *Calcutta Review*, Vol. VI, 1846.

³ Bator is mentioned in Bipradas's *Manasamangala* (1459) and was one of the villages sought from the Emperor of Delhi by the East India Company in 1714-15. It is also indicated in several old maps as well as in Rennell's.

ships were loaded with the merchandise of Bengal. Federici adds that the *bazras* (boats) had to wait for the tidal current, and that it took eight hours from the mouth of the Ganges to reach Saptagram with the full tide. In the Aini-Akbari (1596) Saptagram is already mentioned as decayed. "In Sarkar Satgaon there are two *bandars* about half a *kos* distant from each other; the one Satgaon, the other Hughli. The latter alone pays revenue. Both are in the hands of the Firinghis." With the silting up of the Saraswati during the first half of the 16th century, and further deterioration of the Hughli, Saptagram became extinct as a port. Prince Khurram after his sojourn in Orissa, sailed along the Saraswati in a boat to visit Saptagram, then bereft of its glory. Abdul Hamid, the official historian of Shah Jahan, refers (in his *Badshahnama*) to the ruin of Satgaon, *i. e.*, Saptagram (Elliot VII, p. 32). In 1660 it was described by Van den Broucke as a mere village. A magnificent delta port, which was seventeen square miles in extent, now has nothing to distinguish it but an insignificant mosque and temple and a big mound of ruins of a fort, surrounded by an inaccessible jungle. On a personal visit in 1934 in the mound fragments of a granite pillar decorated with carvings and the figure of a dancer were discovered in a plantain grove. A small dry creek is what remains of the Saraswati, but villagers still indicate a river called the Kunti, a fort and a *goukhana* and speak of old coins and masts and chains of sea-going vessels occasionally discovered in the locality.

There were thus two channels to the sea below Saptagram in the 16th century; the Saraswati passing by Chaumaha, Mandaran, Bator, Tamluk and Hijli to the sea; the other, the Bhagirathi, now called the Adi Ganga, diverging to the east from opposite Bator and passing by Kalighat, Nachangacha and Chhatrabhoga to Hijli. This is borne out by Mukundaram's description (1533-1600) of the

voyage of the merchant prince from Burdwan to the Bay.¹ The cities met with on the right and left banks are arranged in order separately and marked with an asterisk if these are still well-known. The names in Rennell's map (No. XIX), drawn after two hundred years are repeated within brackets.

*Right.**Left.*

Bhirgu Singha's Ghat	Materi Ghat
Chandi Gach	* Santipur (Santipour)
Balanpur Ghat	Oola Khisma Fule (Ula)
* Purvasthali	Joshepur Kodai Ghat
* Navadwip	* Halisahar (opposite Tribeni)
Parpur	* Garefa (Gouripur)
Mirzapur (Marzapur)	* Jagatdal (Bhatpara)
Ambowa (Ambooh)	* Naopara (Garulia)
* Guptipara	* Khardaha
* Tribeni (Terbonee)	Kuchinan
Saptagram (Saatgong)	* Chitpur (Chitpour)
Andalpara or Gondalpara	* Kalikata
Teliapur (Telinipara ?)	
Nimaighat (in Baidyabati)	
* Mahesh	
* Konnagar	
* Kotrung	
* Salkhia	
* Bator	

The following places occurred on the Bhagirathi (the Adi Ganga) beyond Bator :—

*Balu Ghata (Baliaghata)	*Barasat (Dakshin Barasat)
*Kalighat	*Chhatrabhoga
Mirnagar	Ambri Bhuj
Nachangacha	*Hithagar
Vaishnav Ghata	Mogara

¹ Guruprasad Sen : *Bengal in the 16th Century, Calcutta Review*, 1891, pp. 373-74.

It is interesting to find mention of Calcutta, which was accordingly in existence in the 16th century, a fact corroborated by the earlier notice in Bipradas's description and by Van den Broucke's map.

In an older manuscript, Bipradas's *Manasamangala*, (1495) the following cities are mentioned in the voyage of Chand Sadagar from Bhagalpur to the sea :

Rajghat, Indraghat, Nadia, Ambowa, Tribeni, Saptagram, Kumarhat, Hughli, Bhatpara, Boro, Kankinara, Mula-jor, Ganrulia, Paikpara, Bhadreswar, Champdani, Ichapur, Bankibazar, Nimaighat, Chanak, Ramnan, Akna, Mahesa, Khardaha, Rishira, Sukchar, Konnagar, Kotrang, Kamarhati, Eriadaha, Ghosuri, Chitpur, Calcutta and Bator.

Then Chand Sadagar sped along the course of the Adi Ganga and the following places are mentioned as situated on its banks :

Dhalanda (Balanda), Kalighat, Churaghat, Jayadhali, Dhanasthan, Baruipur (here the boat enters the Hunia), Chhatrabhog and Hathiagar.

Among these, the most important places and ghats in the 15th century were mentioned in Krittivasa's *Ramayana* (1422 A.D.) as follows :

Indreswar-Ghat, Mera-tola, Nava-dwip, Saptagram, Akna, Mahesh and Bihoro-Ghat.

The reason why the Bengalee merchant avoided the Saraswati course to Hijli but flowed down the Adi Ganga is explained by C. R. Wilson. "It was not because it was too shallow, but because it was too deep, so deep as to be readily accessible to the galliasses of the Arracanese pirates, whom the voyagers were most anxious to escape."¹ That the country south of Chhatrabhoga was mostly uninhabited

¹ *Early Annals of the English in Bengal*, p. 133.

and full of forests is amply indicated in a description of the Chaitanya-Bhagabata (1573).

The Western Delta at the beginning of the 16th Century. Let us construct, as best as we can, a picture of the western delta at the beginning of the 16th century on the basis of the two accurate maps of De Barros and Van den Broucke and the descriptions of the European travellers and of the two Bengalee authors, Mukundaram and Bipradas. It appears that the Saraswati flowed into the Damodar, diverging from the Ganges near Saptagram, and passing through western Hughli and Howrah by Chaumaha and Madaran. From Saptagram another considerable river, the Jamuna, also branched off to the east passing by Buran (in the map of De Barros), which is Booroogram in east Jessore. The united streams of the Saraswati and Damodar flowed into the Ganges through the present Ulubaria Khal, at present near about Ulubaria, where Van den Broucke shows the Damodar mouth. At a small distance to the south the Rupnarain joined the Ganges. The mouth of the Rupnarain was probably Ragore, indicated in Monserrate's map. Ragore seems to be Radg-Gur on the Rupnarain. Blochmann appears to me wrong in identifying the mouths of the river near Pisacolly (in De Barros' map) as the mouths of the Saraswati, Damodar and Rupnarain;¹ while C. R. Wilson misses the importance of the Saraswati in the 16th century and its relation to the Damodar. He does not identify the Saraswati at all in De Barros' map.² On the other hand, that the Bengalee boatmen sailed down the channels of the

¹ H. Blochmann: *Geographical and Historical Notes on the Burdwan and Presidency Divisions*, in Hunter: *Statistical Account of Bengal*, Vol. I, 1875.

² C. R. Wilson: *Topography of the Hughli in the 16th Century*, J. A. S. B., 1892.

Damodar and Saraswati to the sea is well established by medieval literature. It was not far from Bator that the combined streams of the Damodar and Saraswati entered the Ganges and formed a small delta. At Bator (literally meaning shoreless) it was a limitless expanse of water but shoaling naturally took place at the confluence of the rivers, causing the Portuguese ships to anchor from their advent in Bengal in 1530 up to the last decades of the 16th century. "The small ships," Ceasar Frederici adds, "go to Satagaon and there they lade." Beyond this delta but before the Rupnarain mouth is reached there is Pisacolly. In a contemporary map, Gastaldi's, the right name is given, Picalda, which is a market on the Rupnarain. Pichalda is mentioned also in the Chaitanya Charita as a place feared for pirates. From opposite Bator where the Bengalee voyagers prayed to the mother Goddess,¹ Batai Chandi, and brought their provisions and stores, there diverged towards the east, another channel, safer and perhaps shallower, past Kalighat, Churaghat, Jayadhali, Baruipur, Chhatrabhoga and Hathigar to the sea. This was the alternative route through what is now termed the Adi-Ganga from Saptagram to the sea which Chand adopted. In Van den Broucke's map, which is more accurately drawn after a century had passed since De Barros, the Saraswati is indicated as diverging from Tribeni (Tripeni) when she makes a western detour by leaving Dhaniakhali, Shahnagar and Mandalghat on the right, and instead of flowing into the Damodar rejoining the Ganges near Balia Basundhara in the Howrah District. This is a marshy tract between the Damodar and Hughli, and was probably connected with the Rajapur *bil*, and is west of Bator. The Damodar in Broucke's map sends out a branch from Jahanabad connecting itself with the

¹ The Batai Chandi temple is about 400 yards from the present river near Shalimar. The Bataitola police outpost is also near by.

Rupnarain ; this branch is the Dwarakeswar river or the Kana Nadi, and according to Blochmann, the present Bakhshi Khal near Tamluk. It is interesting to note that Jahanabad, Khanacool and Oodaypoor (Van den Broucke's Jahanabad, Cannacoel and Oedagyns) are all situated on the Dwarakeswar river or Kana Nud, while Barda (Van den Broucke's Barda) is on the present Damodar river. The Saraswati, Rupnarain and Adi-Ganga's mouths are all separate in Van den Broucke's map. The Damodar-Saraswati delta has disappeared, six miles, according to Valentyn, separating the Saraswati and Rupnarain mouths. The decline of the Saraswati in the 16th century subsequently led two branches of the Damodar to flow eastwards. One branch flowed into the Ganges at Niaserai, north of Tribeni, the other flowed into the Saraswati near Nursipur. But none of these branches are indicated in Van den Broucke's map, which, however, shows a large branch joining the Damodar much higher up with the Ganges, a little below Kalna or Ambowa. Blochmann observes in this connection : " At present the land between Salimabad and Kalna contains a large number of khals, conveying the district drainage to the Hughli ; but though most of them commence from places near the Damodar, not one flows now-a-days from it to the Hughli." The river Banka, it may be conjectured, may be a relic of this old Damodar branch. The greatest changes in the course of the Damodar took place in the beginning of the 18th century, since by Rennell's time the mouth of the Damodar shifted to the present position, and again in 1774.

The Hughli, the Main Artery of Bengal. In its lower reaches the Ganges, we find in Van den Broucke's map, received from the east, two tributaries, the upper being probably the Chingry Khal of modern charts and the lower probably the Rogues' River, the abode of pirates, which Yule has identified with the Kalpi

creek. Before entering the Bay, the Ganges split up into innumerable branches, and was hence called there the Satamukhi Ganga, a term used in Krivivasa's Ramayana and the Chaitanya Charitamrita. The Ganga Sagar, where the Bay was reached, was also an ancient place of pilgrimage. Salkhia and Bator have now given place to Howrah; instead of a temporary mart, a village of straw, exhibiting an infinite number of ships and bazars but soon razed and burnt, a large railway and industrial city has now reared its head. But of far greater significance for India has been the expansion on the opposite bank. Chitpur, Kalikata, Kuchinan and Balughat have grown into one of the largest cities of the world under the trend of the same economic forces and influences, which first attracted the Portuguese to Bator, the oldest seat of European trade in Bengal, its importance being due to the fact that the larger ships had to anchor as "upwards the river is very shallow and little water." In close proximity to the place where a considerable number of European ships used formerly to lay in anchor has been constructed one of the biggest docks in the East. As a matter of fact when the English applied in 1714 to the Emperor Farrukhsiyar for a grant of a number of villages the list included Salkhia, Howrah and Bator, for apart from their close proximity to Calcutta "there were docks made for repairing and filling their ship's bottoms, and a pretty good garden belonging to the Armenians" to boot. The French Settlement at Chandernagore, founded in 1676, had neither the commercial advantage nor the strategic importance of Calcutta, as the French themselves learnt to their cost when the British men-of-war under Admiral Watson sailed up the river with the tide and took the French fort in a quarter of an hour in 1757. Admiral Watson brought to the Bhagirathi in front of Chandernagore three or four sixty-four and sixty-six-gun ships. "Nothing beyond a large gun boat can now approach

Chandernagore," wrote Humbley about a century later.¹ The British understood more clearly than any other European power that Bengal was the heart of India, and that the river Hughli was its main artery. We quote the testimony of an English traveller, Forster, who travelled in Bengal in the years 1783-84: "The Ganges affords a grand aid to the English, in all military operations within their own territory; while their armies on the Coromandel and Malabar coasts, are, from a want of provisions and ammunitions cramped and impeded in their motions; and are frequently, for the obtainment of these supplies, compelled to retreat on the moment of reaping the full fruits of victory. But, the Bengal armaments are furnished, from their shore boats, with every equipment; and the Europeans enjoy, in their camps, even the luxuries of life."² But while this explains the growth of English political and economic supremacy, the present decline of the river system in Western Bengal and decay of the hinterland of Calcutta do not augur well for the region's economic prosperity in the future. On both banks of the Hughli, animated by the touch of industrialism, we have a number of mill-towns, which have in some measure replaced the prosperous villages and towns of the 15th and 16th centuries; but a little beyond there are malaria-stricken village and ruined orchard, morass and jungle, whose expansion today is in strange and sad contrast with the phenomenal increase of wealth and population of Calcutta.

¹ Humbley: *Journal of a Cavalry Officer*, 1854.

² *A Journey from Bengal to England* by George Forster, Vol. I, pp. 12-13.

CHAPTER VIII

DECLINE OF THE WESTERN DELTA AND ESTUARY SINCE THE 17TH CENTURY

The Ports and Marts of Bengal in the 17th Century. After completing the land-formation in the westernmost part of the delta by the 16th century, the rivers of Bengal began an era of violent reconstruction in the estuary south-east of the Bhagirathi. In the northern reaches of the Ganges, after the decline of Gaur, Tanda thrived for centuries as the capital of Bengal, and as a commercial emporium. Ralph Fitch (1586) mentions the important town of Tanda as standing at a few miles distance from the Ganges, since the adjacent country, including many villages, was once washed away by it.¹ Here he found great trade and traffic of cotton and cotton cloth. Bakla, Tripura, Sandwip, Sripur and Chandecan in the south were also important markets of rice and cotton cloth in the medieval period. Bakla, pargana Chandradwip in the Bakarganj district, was long the seat of a line of Hindu zamindars, belonging to the group of chiefs known as the Bara Bhuiya, who are described as the "twelve sons of Bengal." These zamindars first ruled in Kachua and subsequently at Madhavapasa. At Shujabad, about 5 miles south-west of Barisal, a great fort was built by Aurangzeb's brother.² The island of Sandwip leapt into prominence as an exceptionally fertile and prosperous spot in the 16th century, and its history under the Portuguese and the Arakanese is full of

¹ *Purchas*, X, p. 181.

² Beveridge wrote in 1876 that the ruins have completely disappeared owing to the encroachments of the river.

heroic adventures and cruel deeds. Sripur, situated south of Sonargaon at the confluence of the Meghna and the Padma, also played an important part in the history of Bengal, being the seat of the kingdom of Chand Roy and Kedar Roy. It was a sea-going port, for Fitch embarked from here for Pegu on a ship passing down the estuary. Later it was destroyed by the Padma. Chandecan has been identified by Beveridge with Dhumghat in the neighbourhood of modern Kaliganj in the district of Khulna,¹ the seat of the kingdom of Pratapaditya. European travellers have, however, referred to the river of Chandecan, which appears to have been a part of the river Hughli or one of its channels near Saugor island. Van den Broucke in fact places it on the estuary of the Sagor river and island.² Fernandez wrote from Sripur in 1599: "Since the settlement of Chandecan is midway between Porto Grande (Chittagong) and Porto Pequeno (Satgaon), it is easy to navigate from there to all the parts of Bengal." Peter Mundy (1634) mentions the following ports of Bengal: Chittagong, Hughli, Satgaon, Pipli and Sripur. In 1660 Sir Thomas Roe also gives the same list but omits Sripur. In Peter Helyn's *Cosmography* (1568) we find the following cities mentioned, Bengala (situated on a branch of the Ganges), Gaur, Tenda, Satgaon ("on the bottom of the gulf of Bangala, a well traded port"), Porto Grande, *i.e.*, Chittagong and Porto Pequeno, *i.e.*, Satgaon. The principal inland trade centres of Bengal in the 17th century also included Malda, Rajmahal, Murshidabad, Dacca and Kachua. Rice, sugar, cotton and silk fabrics were exported to all parts of India, to Maslipatam, Goa and other ports and along the Coromandal Coast and

¹ J. A. S. B., 1866.

² The Rev. H. Hosten: Twelve Bhuiyas of Bengal, J.A.S.B., November, 1913. See also Campos: *History of the Portuguese in Bengal*, Chapter VIII.

to Agra by way of the Ganges and the Jumna. "Dacca," said Manucci (1633), "produced the prodigious quantity of fine white cloth and silken stuffs of which the nations of Europe and elsewhere transport annually several ship-loads."¹ Dacca muslins were regularly supplied to the imperial and provincial courts. Pyrard De Laval (1608-11) mentions that Bengal was a very nursing mother to all parts of India as well as Sumatra, Moluccas and the islands of Sunda, supplying them with their entire subsistence and food. He also refers to the export from Bengal of raw cotton and cotton fabrics to the rest of India and chiefly to the parts about Sunda. Silks were also largely exported.² Arabia, Mesopotamia and Persia are other countries, mentioned by Bernier, where sugar was exported from Bengal, and Ceylon and the Maldives among the places where rice was exported. The chief centres of Bengal's export trade in the Mcghul days were Satgaon, Chandecan, Pipli, Dacca, Sripur and Sonargaon, excluding the various foreign settlements which were gradually rising into importance. The principal centres of ship-building at the time of Mir Jumla and Shais'a Khan (1664) appear to have been Hughli, Baleswar, Murang, Chilmari, Jessore and Karibari, where "as many boats were ordered to be built and sent to Dacca as possible."³ The district of Jessore is still full of marks of old river-beds and of the memories of Iswaripur, Dhumghat, Jahajaghata and Chakasri, now hardly to be recognised as scenes of naval glory.

In the meanwhile the Ganges showed a distinct eastward advance and this meant inevitable decay of the Bhagirathi and other rivers of the old delta. When the main river quitted the channel of the Bhagirathi in the 16th century, and started eastwards to seek another outlet, the

¹ Manucci : *Storia De Moger*, Vol. 2, p. 430.

² *The Voyage of Pyrard De Laval*, pp 327-329.

³ Mookerji : *Indian Shipping*, p. 227.

Ichhamati, the Jelanghi and the Mathabhanga became in turn the main stream. But the river tended ever to the east ; and at last, aided perhaps by one of the periodic subsidences of the unstable land-surface, it cut across the old drainage channels, still on its eastward march, until it was met and checked in its advance by the mighty volume of water of the Brahmaputra . The result of the eastward march of the main stream was the diminution in bulk of the rivers taking off from it on the south, and this decline began more than two hundred and fifty years ago. Towards the end of the 17th century we find the following important places on the Ganges mentioned in the *Khulasatul-Tawarikh* ¹ : Akbar-nagar (Rajmahal), Maqsudabad (Murshidabad), Mirdadpur (not identified), Khizrahati (31 miles east of Murshidabad) and Dacca. Mierdapur, Mexudabath and Hasierhati are to be found in Van den Broucke's map. Mierdapur is Mayrdadpur (Thana—Lalgola) and Hasierhati is Haziragati. Mexudabath is, of course, Murshidabad. In 1666 Tavernier who travelled down the Ganges mentioned having reached a great town called Donapour after having left Rajmahal. Donapour is also indicated in Van den Broucke's map as well as in Moll's and Rennell's. Other towns on the Ganges mentioned by him on his way by the main river to Dacca are : Toutipur (Tartipur), Acerat (which is probably Haziragati), Douloudia, Danpour, Jatrapour, Bagmara and Kasiata ; some of these have now been reduced to mere villages. Teutipor, Acerat and Dampor are indicated in Cantelli da Vignolla's map (1683). Tavernier also visited Malda, Murshidabad, Cossimbazar, Nadia and Hughli, all of which were large towns in this period. He mentions also the interesting fact that Nadia on the Bhagirathi was the farthest point to which the tide reached at that time.²

¹ Mookerji · *Indian Shipping*, p. 227.

² Tavernier : *Travels in India*, Vol. 1, pp. 102-08.

The Bhagirathi became unfit for navigation by the end of the 17th century. In 1666 Tavernier wrote that Bernier had to go over land to Cossimbazar from Donapour near Rajmahal, because a great sand-bank at its mouth before Soutiqui (or Suti) made the river unnavigable. In the estuary of the Hughli or Bhagirathi, too, navigation was hazardous. Methwold writes (about 1620) that in Bengal "we are mere strangers, the coast is too dangerous, and our shipping too great to adventure there among so many shelves and sands."

Early European Settlement. The Portuguese, Dutch and English merchants during this period brought down goods in small vessels along the Hughli and transhipped them at Pipli or Balasore. This course was uneconomical. Thus in 1660 the English Company authorised experimental trips up the river by sea-going ships.¹ By the middle of the 17th century the English had factories not merely at Pipli and Balasore, but also at Hughli, Cossimbazar, Murshidabad, Patna and Dacca. The Hughli factory was established in 1650 and became head factory of the Bay in 1657. Murshidabad was the new capital of Bengal built by Murshid Kuli Khan on both banks of the Ganges. A mile or so away to the southward was Cossimbazar situated on an island which was a great trading centre, and "was one of the first to which the English adventures were attracted."² Manucci found in 1663 at Cossimbazar three factories of the French, English and Dutch. The decay of Cossimbazar was due to the diversion of the Bhagirathi which now flows three miles from the town and the consequent water-logging and malaria so that the margin of cultivation receded and wild beasts increased. Pipli or Pipilipatam on the Subarnarekha River, about 16 miles from its mouth, was the earliest

¹ See Moreland : *From Akbar to Aurangzeb*, p. 48.

² Monckton Jones : *Warren Hastings in Bengal*, p. 23.

maritime settlement of the English in Bengal, founded in 1634, on the ruins of the Portuguese factory. "Owing to change in the course of the river not one stone now remains to mark the spot where the famous port once stood." ¹

In 1690 Job Charnock acquired Sutanati on the Bhagirathi, and also Govindpur and Kalikatta (1693), laying the foundations of the second city of the empire. In Van den Broucke's map three places are indicated: Sootanati, Colecatta and Calcule (Kalighat), near about the present site of Calcutta. The choice of the site of Calcutta for a fort by Job was guided by the considerations that the village was not only a place of pilgrimage but had the best anchorage—in what is now the Long Reach—and at Bator, the site of modern Howrah. the river was narrow enough to be easily crossed for trade without any trouble from the Mahratta raiders. A French Naval Commander, writing in 1725, mentions Calcutta, Chandernagore and Chinsura as the most handsome towns on the Bhagirathi. Cossimbazar, now a notoriously unhealthy place, was an island where also there continued for several decades a flourishing English factory, while the French had a factory at Saidabad and the Dutch at Calcapur near by. But the towns were far eclipsed by the size and opulence of Murshidabad about which Lord Clive said: "The city of Murshidabad is as extensive, populous and rich as the city of London, with this difference that there are individuals in the first possessing infinitely greater prosperity than in the last city." The decline of the Jelanghi, Bhairab, Mathabhanga, and finally of the Bhagirathi, took several centuries. From the 17th to the 18th centuries important European trading settlements thrived on the Bhagirathi in Farashdanga, Saidabad, Cossimbazar, Jungipur, Ghiretty, Bandel, Hughli, Chinsura, Chandernagore, Serampore, Budge-Budge, Matla, Mayapur

¹ Constable and Smith: *Bernier's Travels in Mogul Empire*, p. 443.

as well as on the banks of the Karatoya and the Atrai.¹ The English factories in Bengal prior to 1757 were those of Kassimbazar, Dacca (Jehangirnagar), Luckipore, Patna, Bihar, Malda, Rajmahal, Hughli and Balasore. Of these Dacca and Kossimbazar were the most important. Luckipore, also called Jugdia, a town in Noakhali District, was a centre of trade of Eastern Bengal, and was situated on the mouth of the Meghna.² Six French factories, viz., Chandernagore, Kassimbazar, Dacca, Jugdia, Balasore and Patna, were mentioned in the fourth Article of the Convention of Versailles, 31st August, 1787.³ Cossimbazar, Jungipur, Malda, Rampur Baulea, Coomercolly, Radhanagore and Rangpur were the important silk-marts at the beginning of the 19th century in Bengal.⁴ The navigability of the Bengal rivers, the facilities of harbourage which Bengal offered as well as the enormous wealth from trade and production which the English merchants acquired at the different inland centres in the province paved the road to British supremacy in India.

A Century of River Changes : the Middle of the 17th to the Middle of the 18th Century. A comparison of the rivers and riverine marts and towns of Bengal as indicated in the maps of Matheus Van den Broucke (1658-1664)and Rennell (1764-1776) throws a flood of light on the economic decline of Bengal during a century when most far-reaching changes of the courses of the deltaic rivers were witnessed.

¹ See S. C. Hills : *Three Frenchmen in Bengal*, for maps of the Ganges Valley and the European Settlements in Bengal (after Rennell); also Das Gupta's *India in the Seventeenth Century*, for early European Settlements.

² Monckton Jones : *Warren Hastings in Bengal*, p. 36.

³ *Cornwallis in Bengal*, p. 93.

⁴ Valentine : *Voyages and Travels*, p. 77.

*Change of Rivers in Bengal between the
17th and 18th Centuries.*

Van den Broucke's Map, 1658-1664.	Rennell's Map, 1764-1776.
<ol style="list-style-type: none"> 1. The Ganges divides into a number of broad channels near Rajmahal. 2. Two large islands are formed by two broad streams of the Ganges east of Rajmahal and again north of Murshidabad and south-east of Tanda. 3. The Ganges divides into two channels again at Murshidabad and forms a fairly big island. 4. The Ganges forms another big island with "Caatgam" (Saptagram) on the north, and Calcutta on the south. The whole area is thickly dotted with river ports and marts—both the streams being navigable. The western stream is the Saraswati and the eastern the Bhagirathi. Near Kalighat (Calicule), the Bhagirathi swerves to the right (Adi Ganga) to fall into the Sagar river. 5. Two streams fall into the Bhagirathi—one from the east, viz., the Damodar and another from the west, the Jelanghi south of Nuddea at Ambowa (also mentioned by Rennell). 	<ol style="list-style-type: none"> 1. There are only two channels forming an island between Sicrygully and Rajmahal. Major Colebrooke, writing in 1805, referred to a considerable gathering of islands between Rajmahal and O-udanullah. 2. The islands are no longer there. 3. The island is very much smaller. 4. The island is no more visible. The Saraswati does not appear. Saptagram is not mentioned. The only towns indicated by Orme are Purrua, Siringanagar, Hughley and Chandernagore. 5. These are no longer visible on the map.

Van den Broucke's Map, 1658-1664	Rennell's Map, 1764-1776.
<p>6. Eight western rivers in a series are shown, all fairly broad and navigable: (1) the Ajai river: at its confluence with the Ganges two river ports are shown—Oedapoer (Udhanpur) and Bickihaat. (2) The Damodar one branch of which (probably the ancient channel of the Banka) meets the Bhagirathi at Ambowa and the other diverging near Jahana-bad and passing through Khanacool meets the (3) third western river, the Rupnarain at Nareingar. From Nareingar, the Rupnarain proceeds due east into the Ganges as the "patragatta" river near the mouth of the Hooghly. Sjandercona (Chandrakona) and Medinapoor (Midnapur) are two other important towns on the Rupnarain. On the Patragatta river stands the important town of Tamboli (Tamluk). The (4) fourth western river is the Suvarnakha which with a loop near Pipli falls direct into the Bay near Culpee. Danton, Pipli and Jaleswar are important ports situated on this river. The (5) fifth and the (6) sixth western rivers are the Buralang—with Balasore as its port—and the Byturni with Bhadrak (now situated on its tributary, the Salandi) and Port Palmeiras as chief towns situated on it. The (7) seventh western river is probably the Brahmini. The (8) eighth river is the Mahanadi on which Cuttuck is shown.</p>	<p>6. The Ajai has lost its importance by the time of Rennell. No port or town except Mungulcote is shown on it. She meets the Bhagirathi at Katwa.</p> <p>A small river, the Banka, takes its rise from the Damodar near "Sonamooky," goes eastwards and falls into the Ganges near Krishnanagar. The Damodar which formerly flowed eastward after crossing Burdwan, now turns perpendicularly southward from Burdwan to the Bay. Its two branches called Behula fall into the Bhagirathi.</p> <p>Nareingar is yet shown on the river Rupnarain. The Rupnarain now falls into the Hooghly estuary at Gewankhally where the Damodar and the Bhagirathi also pour turbid waters.</p> <p>Both the Haldi and Rasoolpur channels, once the chief entries to the delta, have now dwindled into insignificance.</p> <p>The Suvarnakha making a loop near Pipli falls direct into the Bay near Culpee.</p>

Van den Broucke's Map, 1653-1664.	Rennell's Map, 1764-1776.
<p>7. The Bhagirathi is much broader on the map, expanding since the decay of the Saraswati in the 17th century.</p> <p>8. The Mahananda took a more westerly course.</p> <p>9. The Atrai, Dhaleswari, Karatoya and Sitalakshya (Lecki) are rivers of considerable importance and the Tista has not as yet emerged on the scene. South of the Burhi-Ganga, and flowing almost parallel to it was probably the Kali-Ganga through which the Kirtinasa later forced its way at the end of the eighteenth century. Between Haziragati and Dacca Tavernier (1666) mentions a river called Chativor coming from the north. This is probably the Karatoya. Several miles beyond he also describes the Ganges as dividing into three branches one of which goes to Dacca. He stopped at the entrance of this channel at Jatrapour. Jatrapour, near Dacca, is also mentioned in Hedges' Diary. A mile beyond the confluence of the Lakshya and the channel of the Ganges he encountered another river Pagalu coming from the north-east and another mile lower down the Cadamtali coming from the north. These rivers do not seem to appear in Van den Broucke's map.</p> <p>10. Only one of the Nadia rivers is indicated, viz., the Jelanghi, a large navigable river, and another considerable, important river in Jessore district is charted, viz., the Madhumati.</p>	<p>7. By Rennell's time the Bhagirathi, however, appears to have become again an unimportant stream of the Ganges as in the 16th century.</p> <p>8. The Mahanada flowed through Malda and Lucnoui.</p> <p>9. The Atrai, Karatoya and Dhaleswari have decayed and the Tista has become a mighty river, but flowing south down the bed of the Karatoya, instead of south-east as at present, and joining the Atrai at Dinajpur, finally falling into the Ganges.</p> <p>In the destructive floods of 1787 the main stream of the Tista forsook its channel and forced its way into Ghoraghat. This latter stream was unable to carry off such a vast accession to its waters. Thus the Tista spread itself over the region ultimately succeeding in cutting for itself a new and capacious channel by which it found its way to Brahmaputra at Phulcharighat.</p> <p>10. Several rivers of Central Bengal are indicated.</p>

Van den Broucke's Map, 1658-1664	Rennell's Map, 1764-1776.
<p>11. The waters of the Brahmaputra flowed through the channel of the Sitallakshya and the old bed of the Lohitya across the district of Mymensingh.</p> <p>12. North of the confluence of the Sitallakshya, the Brahmaputra and the Meghna was Karab (Catterbo), of which the capital city was Sonargaon. South of the confluence was Idrakpore where the Ichhamati met the Brahmaputra.</p> <p>13. The confluence of the Ganges and the Meghna was near Sripur, south of Sonargaon. Ralph Fitch (1585) described the city as "standing on the river of Ganges" and he left Bengal, embarking here, and passing down the Ganges and the island of Sandwip. The Meghna or Meghnada is called the Boom (Nada) river, and an island called Cassimpoor, is indicated bounded on the north by Sonargaon and on the south by Idrakpore and Sripur and formed as a result of the coming together of the four rivers, the Lakshya, the Brahmaputra, the Dhaleswari and the Meghna. Cassimpore is Kasimpur Selapati in Grant's revenue roll</p>	<p>11. The Sitallakshya also has considerably declined.</p> <p>12. The Brahmaputra left the old bed of the Lohitya but still flowed through the centre of the district of Mymensingh to join the Meghna near Sylhet. In the early part of the 19th century the river swerved and meeting the Tista coursed through the channel of the Jamuna. rebuilt Northern Bengal and joined the Ganges at Goalando. The united stream of the two rivers flowing south-east destroyed many villages and cities of Vikrampur obtaining the appellation of Kirtinasa.</p> <p>13. The confluence of the Ganges and the Meghna was near Dakhin Sahabazpur island.</p> <p>Within thirty years of Rennell's survey the Ganges joined the Meghna in close proximity to its present junction under the appellation Kir inasa about 70 miles inland.</p>

Decay and Death of Rivers in Northern and Central Bengal. In Northern Bengal the Karatoya, the ancient river which formed the eastern boundary of Paundravardhan, was found active in the beginning of the 19th century; in 1810 it was described as "a very considerable river, of the greatest celebrity in Hindu fable." Formerly it carried the waters which now flow through the channel of the Tista, joining the Atrai in Dinajpur, finally falling into the Ganges. About 1767 the Tista changed its course and broke away to the east. This precipitated the changes as a result of which both the Karatoya and the Atrai rapidly declined and both are now rivers of minor importance, little used for navigation. In the early part of the 19th century the Mahananda near its mouth was separated from the Ganges by a line of chars and began to decline finally joining the main river near Rampur-Boalia. Yet a considerable commerce was carried on the Mahananda at this time, Martin mentioning the marts of Ayiyarganj, Mangalbari, Malda, and Nawabganj. At the first mart, Ayiyarganj, the Mahananda received the Punarbhava which in its course through Dinajpur is described by Martin as very much interrupted with sands. Another tributary of the Mahananda, viz., the Nagor, was also not navigable even for canoes in its upper part. But the Tangan was an active river at this time admitting of boat traffic throughout the year. Martin mentions three artificial canals, one communicating between the Tanjan and the Punarbhava, another between the Punarbhava and the Brahmani in the district of Dinajpur, and the third connecting the Atrai and the Dhepa. The third canal called the Panjra Kata has greatly declined since the change in the Tista course. The first was constructed by Raja Ramnath. The second was constructed by a merchant, and it enormously increased the Brahmani and facilitated heavy boat traffic in both the rivers. The Atrai, still the most considerable river in Northern Bengal at the

beginning of the nineteenth century, shoaled since the deviation of the Tista; vessels carrying heavy load could not ascend beyond Jharvari. All marts in its upper reaches had rapidly declined on account of the deterioration of the river. Martin describing the river changes since Rennell's survey concludes: "On the whole it must be evident that changes in the course of rivers are attended with great loss and inconvenience. The new channel is so much land lost, and the old one leaves behind it a marsh or a kind of lake, which for ages is rather injurious than of use. At the same time vicinity of the new course is deluged with water from the smallness of the channel and the banks of the old course are often deprived of fertility, and still more certainly of the means of conveying their produce to the market. The towns must, therefore, disappear, and the uncertainty of their place of abode seems to be one of the reasons which prevents the inhabitants of Bengal from building more substantial and comfortable houses. The forming new cuts for the purpose of commerce seems on this account very dangerous, and except near the sea should in general be avoided."¹

For Western Bengal Rennell found in 1781 that the Bhagirathi as well as the other Nadia rivers were not navigable all the year round. In 1801 Colebrooke stated that the Gorai and Chandni were the only channels in the western portion of the Ganges delta which were navigable throughout the dry season, and that the Bhagirathi and Jelanghi could not be relied upon. It will thus appear that so far as the Bhagirathi is concerned she had a relatively brief spell of activity as a river. The death of the Saraswati and the extinction of Saptagram may be fixed at 1600 A.D. by which date the Bhagirathi superseded the Saraswati, as the

¹ Martin: *The History, Antiquities, Topography and Statistics of Eastern India*, p. 605.

Saraswati had in the 12th century superseded the Bhairab as the most important western spill channel of the Ganges. On the other hand, that shoaling commenced on the Kasimbazar river as early as the end of the 17th century is clearly discernible from the accounts of Bernier and Tavernier (1666-76). At least from the middle of the 17th century sea-going vessels found it difficult to negotiate the "shelves and sands" of the Hughli estuary, and river and country boats moved up and down, Pipli and Balasore taking the place of Bator of the preceding century as the ports of transhipment for the European merchants. By the time that Rennell (1781) and Colebrooke (1801) reported the deterioration of the Bhagirathi had gone further. De Grandpre who sailed along the Hughli wrote in 1803: "When the French company was first established in the country (Bengal), ships of war of seventy-four guns came to Chander-nagore, but afterwards they were obliged to stop at Mayapoor, and at present can reach no further than Cadgery, a small village at the mouth of the river." About Cadgery or Kedgerree, we read in the Journal of Maria Graham, who came to Calcutta in 1811: "Kedgerree is about half way between Calcutta and Saugor, where the Hooghly widens to a bason, which forms the harbour. Here is a *bazar* and village. It is not uncommon for ships to lie here a long time in the rainy season, when the tides are not strong enough to influence the river against the freshes or floods occasioned by the rains. Men of war seldom go higher up the river unless for repairs."¹ The Bhagirathi, the Jamuna and the Bhairab have all declined during the last century and a half. The Bhairab at one time flowed across the present districts of Murshidabad, Nadia, Jessore and Khulna into the Bay, but was intersected and cut into three pieces by the Jelanghi and Mathabhanga. In its upper course it at

¹ *Journal of a Residence in India*, p. 154.

first silted up. As early as 1794 shoaling on the Bhairab attracted some notice. But the river was subsequently forced open again by the floods in 1874 at its intake from the Ganges, and expanded into an important distributary which pours its water into the Jelanghi 40 miles farther south. The result was that the channel of the Jelanghi above the point of junction began to close up, and the Bhairab is now the channel by which the Jelanghi proper derives its water supply from the Ganges. Lower down its main current was diverted down the Kabadak and the river is little more than a line of marshes now near Jessore town.¹ The Jelanghi and the Mathabhanga became for some decades active channels of the Ganges after the latter's diversion into the Padma, but now these as well as the Ichhamati, the Kumar, the Chitra, the Nabaganga, the Kabodak, the Betna and the Bhadra are now decadent. The gradual but continuous rise in their beds has brought about a general derangement of levels so serious as to affect the natural drainage of the whole region, and cause malaria to assume devastating proportions. This had led to a phenomenal economic decline in the districts of Murshidabad, Nadia and Jessore. In Van den Broucke's map, the waters of the Rupnarain and the Damodar combined and flowed through the channel of the Patragatta (the name probably given to that portion of the Rupnarain) into the Bhagirathi. At present the Rupnarain, the Damodar and the Bhagirathi meet together near the estuary at Gewankhally. Both the Saraswati and Bhagirathi in Broucke's map were considerable rivers, the Jamuna not appearing at all. The decline of the Bhagirathi began in the seventeenth century and has since continued especially in its upper reaches. It was only a few years ago that river steamers ran straight up from Calcutta to Allahabad along the Bhagirathi ; now there is

¹ Hunter : *Imperial Gazetteer*, Vol. VII, p. 41.

not enough water in the river to take any but the lightest boats, and this only at certain seasons of the year. In spite of dredging and training operations intended to prevent the deposition of silt at the two mouths through which head water is supplied from the Ganges, which have been carried on more or less for nearly a century, it will be not long before the outlets will become extinct or seriously reduced in size. The bed of the Bhagirathi near Chhapghati is now raised above that of the main stream; and several miles of sandbanks intervene between the Ganges and the Bhagirathi channels. It is only during the rainy season that the Bhagirathi can now receive water from the Ganges; in summer it is fordable in many places, sometimes the current ceases altogether, and the channel becomes full of weeds. Further, the Jelanghi and Churni, in common with the Bhagirathi and supplying it with head-water, are also deteriorating because of the tendency of the main Ganges river to march eastwards. The normal levels of the river Ganges have been much lowered leaving the beds of all the distributory rivers at a comparatively higher level so that now the river Bhagirathi is only a spill channel of the main river Ganges, and only flows when the water level of the latter is comparatively high. Considerable siltation has occurred in the upper length of the Bhagirathi, while the capacity of the river has been reduced in its lower reaches. For several years efforts were made to keep the mouth of the river open by dredging but were unsuccessful as the dredged bed rapidly resilted due to the shallow water surface slopes available. Hence since 1911, it has been the practice to train the river by the process of *bandalling* with the object of concentrating whatever flow is available in the river in one big channel. More water comes into the Bhagirathi from the Rupnarain than from the Ganges, and the inflows from the Jelanghi and Churni are negligible, excepting during the rains. Even these are not sufficient to explain the

volume of the river up in Calcutta or Barrackpore. What keeps the Bhagirathi going is not water from other rivers but percolation.¹ The river is really a deep irregular trench in the soil, and it fills up with water in a similar manner to the deep tanks in Bengal. It retains its depth partly because of the tides that prevent the silt from settling, but chiefly because the dredging and *bandalling* are continued incessantly. If the dredging or bandalling were stopped the river would first become a swamp and then cease to exist. Though the Bhagirathi has greatly deteriorated, conditions at the mouth both of the Mathabhanga and the Jelahgi have improved somewhat in recent years. There have been changes in the Ganges which though threatening the Hardinge Bridge at Saraghat, promise to make easier the improvement of these rivers. The tendency is now for the main channel of the Ganges to flow along its southern bank ; and where as a few years ago the head of the Mathabhanga was choked by a sand bank, a wide and deep channel now passes it and there is extensive erosion on either side of it. The Irrigation Department is now examining schemes for drawing more water down the Jelahgi and the Mathabhanga and the possibility of utilizing the supply of water in these rivers for developing their distribution and it is hoped, if this is done, it will prove possible to improve the Mathabhanga and Jelahgi and open out their off take at the same time.²

Shoaling in the Hughli. There is, however, on the whole, clear evidence that the delta-building functions of the rivers immediately to the east of the Bhagirathi and the Hughli have now ceased ; the main Ganges river now carries its burden of silt-laden water away further to the east, beyond

¹ Kim's Notes in *The Statesman*.

² Sir John Anderson's Speeches at Krishnagore and Berhampore, January 14 and 16, 1936.

Kushtia. This is indicated not only by the decline of the whole Bhagirathi river system but also by the fact that the rivers in Khulna, which is a new delta-formation, do not now act, as once they did, as active distributaries of the Ganges, and the silt they carry is brought down only by the drainage of Jessore district and part of Faridpore. The diversion of the Damodar has destroyed the last chance of saving the Hughli. It may be that the Damodar's new channel to the Bay is an old course of the Saraswati or the Bhagirathi, but at Gewankhally the Damodar and the Rupnarain threaten to shut up the Hughli river, there being no longer a counter-balancing pressure from the declining Nadia rivers to keep it open. The origin of the dangerous moving shoal, known as James and Mary Sands, is due to changes in the course of the Damodar and Rupnarain; the angles at which both the rivers debouch into the Hughli being favourable to the deposit of silt which the close proximity of the two mouths enhances. It is probable that the Bhagirathi and the Hughli will now decline much faster, and that the river will be liable to predominant tidal action which will show itself in the formation of shoals. Curtailed supplies of head-water may cause the wider portions of the river to contract as the waterway adapts itself to new conditions in maintaining its outflow; and when these supplies finally cease the river will probably become extinct as such, and remain only as a tidal estuary with no head-water. Anxieties attend the work of the Bengal Pilot Service on the Hughli, well known for their skill and courage, and several disasters to vessels are recorded.¹ "Every day there a shifting of some channel, a wreck on the 'James and Mary,' a new chart which only a registered pilot may use, and even he only for a few hours on the certified day of issue!" At Sakrail, four miles

¹ Beattie: *On the Hooghly*.

below Calcutta, there was formerly sufficient water for the deepest draught vessels to cross at low-water. Now at the end of the dry season, there is only about 17 ft. 6 in. depth of water available. Middleton bar, 82 miles off Calcutta, is essentially a sea-bar, and not affected by the ebb-tide scour. Here also there has been deterioration, which has brought down the level to 14 ft. at low-water. Ships carrying merchandise are increasing in size and in the depth of water they draw. Thus large ships have to arrange long in advance their times of arrival and departure with the port authorities at Calcutta. Cases are not unusual of ships being compelled to leave their moorings earlier in order to go over the Middleton bar with a full floodtide. If ship-owners in various parts of the world begin to have doubts about the advisability of vessels calling at Calcutta, its pre-eminence as a shipping port will be in the gravest danger.¹

The colossal expenditure on the Kidderpore docks has been a futile waste, for there is grim irony in providing docks for ships of maximum size and draught for the Suez canal traffic if these cannot pass up and down the river.

Calcutta's Peril. It is the steady decline of active deltaic conditions of the region which will in all probability bring about the ruin of Calcutta as a port. The Hughli in its lower reaches will gradually become as shallow and as full of dangerous mud-banks as the Rupnarain, the Rasulpur and the Haldi channels through which sea-going vessels formerly entered the port of Tamluk ; and the port of Calcutta will one day be remembered only with ancient Tamluk or Satgaon on the tablets of history. Bishop Heber

¹ See C. J. Wilkinson's letter to *The Statesman* in connection with the Howrah Bridge controversy, June 2, 1927; also the discussion at the Rotary Club on the deterioration of the Hughli, March 18, 1930.

traversing the Ganges not far from the ruins of Gaur had a similar apprehension. "It is impossible to pass Gour without recollecting that what Gour is Calcutta may any day become, unless the river in its fresh channel should assume a more fatal direction, and sweep in its new track our churches, markets, and palaces (by the way of the Lall Diggy and the Balighat,) to that salt-water lake which seems its natural estuary." It is noteworthy that the question of the disposal of the Calcutta sewage has recently become very serious with the decline of the local deltaic river the Bidyadhari, which is connected with shallow salt lakes back of the city, and into which the sewage of Calcutta is discharged. Up till 1830, the Bidyadhari was one of the most active channels of the Gangetic delta, and one of its numerous spill-*khals*, viz., the Central Lake channel, extended itself right up to the city of Calcutta. But both the Bidyadhari and the Lake channel began to deteriorate at an alarming rate, such deterioration being probably accelerated by the construction of canals for the purpose of navigation which cut into the natural line of drainage. Quite a number of artificial canals have been constructed to connect East Bengal with Calcutta ; and, indeed, this is one of the most important systems of river canals in the world judged by the large volume of traffic. (1) In 1777 Tolly canalized an old bed of the Ganges from its confluence with the Hughli at Hastings, and carried the so-called Tolly's Nullah east to meet the Bidyadhari at Samukpota, thus giving access to an inner route which leads eastwards from Port Canning. (2) In 1810, an old channel through the salt-water lakes was improved and led westwards by what is now known as the Beliaghata canal. (3) In 1826 and 1831 a number of tidal channels were utilised and connected by cuts to form a new route between Calcutta and the Jamuna Canal; and the circular canal from Chitpur was constructed to meet the old eastern canal at Beliaghata.

- (4) The New Cut was opened in 1859 leading from Ultadanga south-east to Dhapa on the Beliaghata canal.
- (5) In 1899 the Bhangar channel was canalised, completing the inner channel which was begun in 1831.

It is for the engineers to find out which of the large number of cuts and channels has, by cutting across the natural lines of drainage, accelerated the process of silting up of the Bidyadhari ; or whether the Bidyadhari would have declined on its own account because of the natural decline of the river system of which it forms a branch. It is probable that the engineers' unskilful interferences with natural drainage by means of artificial canals, locks, and roads have quickened the forces of decay of the moribund river system with which the Calcutta's future is so vitally bound up. Now at least one half of the Bidyadhari is dead ; and, unless emergency dredging is resorted to, the other half will cease to be a drain for the Calcutta sewage and storm water ; and as a Government Committee reported, " the city will soon become uninhabitable." Such dredging became imperative immediately the salt lakes were reclaimed, and the waterway lost its head-water supplies and became subject to predominant tidal action. It is probable that owing to a decline of true deltaic conditions in the Barind when the river system deteriorated, disease and pestilence overwhelmed the ancient city of Gaur. The death of the Bidyadhari is only part of a much wider deltaic problem with which the future existence of Calcutta is intimately involved. It is, indeed, strange that the question has not aroused the attention it deserves, and has provoked not co-operation, but acute controversy among the authorities concerned. Thus the Irrigation Department having to some extent usurped from Calcutta its natural line of drainage for the purpose of inland navigation, has now definitely refused to maintain the Bidyadhari ; while

the Local Self-Government and the Calcutta Corporation have not yet come to a mutual understanding as regards each other's responsibilities. Meanwhile the city has been discharging into the Bidyadhari, whether dry or flowing, sixty million gallons of sewage per day. The Kasba area, adjoining the new Ballygunge extension, has lost practically all means of drainage since the Bidyadhari has deteriorated, and during the monsoon rain water filled with sewage invades the households. North of Calcutta, the Dum Dum, Cossipore and Chitpur municipalities are in great need of drainage, and it is possible that a solution will eventually have to be sought in a scheme for pumping. This also applies to Manicktola, large portions of which are now as low as the level of the Canal, and lower than that of the salt lakes. The author of the *Akbar-i-Muhabbat* thus describes Calcutta as seen by him in the last years of the 18th century: "Calcutta is a large city, situated on the banks of Bhagirathi. The land on account of its vicinity to the sea, is very brackish and damp." Calcutta, like all deltaic cities, was first built along the natural levee, but has now expanded over the marshy back country. With the deterioration of the river system the whole of the area south-east of Calcutta is in a water-logged condition. During the heavy monsoon rainfall, the surface slope tends to convert the area back from the river into a lake. A costly system of covered drains collects surface and ground water to a depth of several feet, but cannot cope with the heavy showers during the rains, and often the city is flooded, and garbage and other refuse float in the public thoroughfares where boats would ply. With the silting up of the salt swamps, and the Bidyadhari channel, the problem of storm-water and sewage disposal has become acute. Cholera, small-pox, typhoid and other diseases are rife as a result, and the general death-rate of Calcutta continues to be very high. Perhaps the construction

of canals, which may collect waste water and serve as highways as they do in Rotterdam, or the distribution of pumping plants throughout the city as in the other delta city of New Orleans, which may accelerate the flow of rainfall water and refuse into the Bidyadhari, might defer the problem of sanitary disposal for the present. It is also suggested that the existing Calcutta canals might be deepened to afford better drainage capacity and to allow of fresh water being run through them instead of their being full of filthy stagnant water, and the breeding grounds of anopheles mosquitoes might be pushed further east.¹ The reclamation of the Kristopur area, including the Jatragachi Chandiberia and Dhapa Bill areas, might be undertaken on Dutch lines by impoldering and endyking, by means of weirs, ring canals and pumping engines, superseding shallow waters by deep lakes and converting low lands into high and easily drained land for market-gardening and fruit-culture.

¹ Townend : *Development of Decadent Areas in Bengal*, pp. 15 and 16.

channel of the Brahmaputra to the south of Agrasindhu having silted up, the river took an easterly direction and joined the Meghna first at Narsingdi through the Arialkhan channel and then at Bhairab Bazar. The continual process of elevation of the tract of old alluvium lying between the old bed of the river and the Arialkhan and the great earthquake of 1762 were responsible for the eastward course of the Brahmaputra. But even this was temporary. A similar process of silting up on a large scale seemed to have been going on in the upper reaches of the Brahmaputra, and a large volume of water was flowing since the end of the 18th century through some of the off-shoots of the Brahmaputra which developed into the Konai or Jamuna channel. In 1805 Buchanan Hamilton spoke of the Jamuna thus: "The Konai is of great size and formerly went with a winding course into the Natore district, but between the towns of Bhabaniganj and Dewanganj the Brahmaputra has made an irruption and has carried away a great part of the channel. In return the Brahmaputra gave a large supply of water to the lower part of the Konai, which now passes behind Dewanganj scarcely inferior to the mighty river and threatens to sweep away the intermediate country." All this movement was probably partly due to the changes occurring in the Madhopur jungle and partly to the silting up of the Sylhet *bils*, but the consummation of the change was largely effected by the violent floods of the Tista, which, indeed, speeded up the change that was already taking place in the course of the Brahmaputra. Since 1787 the main stream of the Brahmaputra has followed the Jamuna river joining the Ganges at Goalundo, and the other streams have silted up and become useless for irrigation. About the beginning of the 19th century, the river occupied its present bed and, flowing almost due south, joined the Ganges near Goalundo, and effectively checked its further progress eastwards. At the time of the Revenue Survey it

was found that further south the two rivers have deserted the Arialkhan bed and moved eastwards, and later still they joined the Meghna at Rajbari.

The mighty floods of the Tista of 1787 are thus indirectly responsible for transforming the entire landscape of Dacca and Faridpur districts. Neither the Kirtinasa nor the Naya Bhangini which, indeed, speeded up the change that was already taking place in the course of the Brahmaputra, existed prior to these floods. When the waters of the Jamuna and Padma combined, a new opening through Vikrampur was cut out to the eastward for entry into the Meghna, and this was the Kirtinasa which destroyed the far-famed temples and palaces of Chand and Kedar Roy and later of Rajbulluv. Similarly the Meghna devoured large slices of Tippera and Bakarganj in 1767, and in 1703 at the north-east boundary of Bakarganj broke through to the westward in a single night by an opening called the Naya Bhangini (new opening) into the Arialkhan, a branch of the Padma. It was the floods of 1787 in Bengal which ushered the movements that led both the Brahmaputra and the Meghna to change their ancient beds, refashioning the landscape altogether in the vast low land extending from the northern part of Dacca to the north-east boundary of Bakarganj district.

In its upper reaches the Meghna is known as the Surma. It flows between Sylhet and Mymensingh, and between Narayanganj and Chandpur. The combined river enters Bakarganj with a width of some 10 miles, but it then opens like a fan, forming three channels with two great inland wedges in between, two of which reach the Bay independently. The western channel, Ilsa Tentulia river, which is a continuation of the Arialkhan bed—which was formerly the main channel—will decline as one of the many internal rivers of Bakarganj. Great changes have been going on in the estuary. In the mainland of Bakarganj, delta formation is

practically complete, although the level of the land will still no doubt rise slowly. Within a century the main stream of the Meghna has moved 20 miles eastward. The great rivers are now concentrating their attention on the watershed which divides this mainland from Chittagong, and the view is strongly held that the 20th century will see the development of the eastern part of the present estuary into a more or less solid block of land.¹

Need of Scientific River Study and Survey. It is difficult to give a comprehensive and accurate account of changes and developments of rivers in Bengal. Ancient myths such as the saint Bhagirath's beckoning Ganga and her mistaken detour eastward on hearing the sound of Padmabati's conch-shell are reminiscent of mighty happenings in the delta. Centuries ago the Ganges probably showed an eastward trend, and Bhagirath represents the traditions of ancient river engineering which faced the danger to Central and Western Bengal, then as now the most Brahmanical and cultured area in Bengal, by coaxing the Ganges and drawing more water down the westernmost spill channel, the Bhagirathi, by dredging and canalisation at the head. The agricultural catastrophe which faces Bengal to-day may have confronted her several thousand years ago, the natural course of the Ganges being always eastward. Most districts in Bengal have legends which are memories of sudden changes in the courses of rivers, great or small, affecting local prosperity. While it is not always easy to interpret such myths, legends and folk-tales, the boundaries of ancient as well as modern administrative divisions in Bengal were as a rule marked by courses of the larger rivers. Thus the demarcation of *bhuktis* in medieval Bengal and the Moghul distribution of *parganas* which were geographical as well as the subsequent changes

¹ *Vide* A. C. Sen : *Report on the System of Agriculture and Agricultural Statistics of the Dacca District* ; and Jack : *Bakargunj Settlement Report*.

in administrative divisions indicate the development of rivers. Such important literary traditions as the itineraries of Chand, Dhanapati and Srimanta and the descriptions of Chaitanya's pilgrimage to Orissa throw light on the development of important navigable rivers. The description of the European travellers from Ibn Batuta (1325-1354) to Buchanan Hamilton (1807-1810) contain a mine of information which has not yet been adequately utilised. Certain invaluable maps such as those of Van den Broucke (1658-1664) (supplemented by Valentine's descriptions) and Thornton need careful scrutiny in order to understand changes in the courses of the rivers, and the rise and fall of towns situated on them. When we reach the end of the 18th century, Rennell's survey and maps (1764-1776) and notes and comments on these by La Touche and Hirst serve as an accurate basis of comparison. Comparison of the present Settlement maps with the maps of Rennell and Whitchurch (1776) and Revenue and Survey maps prepared in the middle of the 19th century is the chief method of ascertaining the development and decline of the rivers in more recent times. Many deserted river-beds are discernible throughout Bengal; traditions float about in different localities about the magnificent display or sinking of boats of Chand Sadagar, Dhanapati and Srimanta or the course of the river by which Behula's raft took the corpse of Lakhindar which three distinct legends distribute in Western Bengal, Eastern Bengal and North-eastern Bihar respectively. Local riverine surveys should be undertaken to chart the successive channels through which a particular river has coursed from epoch to epoch; these are especially important in the lower delta where the rivers meander most, leave little traces behind and change their names every few miles. One may easily understand the bewilderment of Montgomery Martin more than a century ago who in the course of a survey of the districts of Upper Bengal, where remarkable river developments were then taking place, found that rivers not merely

changed their places but also their names too frequently. "European geographers endeavouring to trace a great river from where it joins the sea to its most remote source by its principal channels are astonished to find that it sometimes loses its name altogether ; or again, another river after having for some part lost its original name, traced further, is found with its former name restored. They are apt to be enraged when in tracing a river they find that an inconsiderable stream falling into their grand channel changes its name and that the source of this smaller stream is obstinately considered by the natives as the source of the river, having either been the first to which they had access, or having at one period been the largest."

The Six River Systems of Bengal. In Bengal there are six distinct river systems: (1) the North-western and (2) North-eastern Bengal river systems, which are south-flowing ; (a) the Mahananda-Atrai system in North-western Bengal and (b) the Karatoya system in North-eastern Bengal with the Barind in between ; (3) the Western Bengal river system composed of the tributaries of the Bhagirathi, *viz.*, the Ajay, Mayurakshi, Damodar and Rupnarain which are east-flowing. The hard red soil in Burdwan has marked the western limits of the courses of the Bhagirathi ; (4) the Ganges system, with its several spill channels in Central Bengal flowing in a south-easterly direction. The Nadia and Jessore rivers are the two groups of spill channels of the Ganges ; (5) the Brahmaputra system the direction of whose flow has changed most in the struggle for territory with the newest river system in the heart of the lower delta in Bengal, *viz.*, (6) the Meghna system, which is now actively building the estuary on the east of the Bay of Bengal.

The Madhopur jungle, the rolling upland rising to 100 feet above flood level and extending for about seventy miles due north of Dacca, formerly separated the territories of the Ganges and the Brahmaputra whose natural course was

through the low lands and *jheels* east of it. But now the Brahmaputra has swerved to the left of the old and high alluvium, which has effectively opposed the advance of the great rivers and compelled them both to seek a course through the low land to the south-east. The entry of the Brahmaputra, which is quicker than the Ganges, into the Gangetic territory has opened an era of struggle with which is implicated closely the strength or decline of the two groups of distributaries of the Ganges in the western delta, *viz.*, the Nadia and the Jessore rivers. Formerly, before the opening of the Jamuna channel, the waters of the Brahmaputra and Meghna were pressed between the hills of Tippera and the Madhopur jungle; now the waters of the Ganges and the Brahmaputra share between them the eastern half of the Bengal delta from the Haringhata to the Tentulia estuary, where the fluvial forces of the two rivers will be more and more concentrated.

Changes in North-west Bengal. In the north-west the uplands of the Barind form a watershed draining on the west into the Mahananda and on the east into the old Atrai-Tista. Most of the rivers including the Mahananda flow north and south. The Tangan and the Punarbhaba are important tributaries of the Mahananda in the east as the Kalindri is in the west. The silting up of Kalindri connections with the Ganges caused a decline of the Mahananda which has now become fordable even as far down as Nawabganj near the Ganges. The river Tangan has changed its course a great deal, and both the Tangan and the Punarbhaba have been affected by the construction of the railway.

But the river the change of course of which has vitally affected the river system in Central and Western Bengal, is the Kosi, the principal river of Nepal, which till recently joined the Ganges north of Colgong. The Kosi once formed the eastern boundary of Mithila and then separated

the two districts, Purnea and Bhagalpur. In the early part of the 18th century the Kosi passed below Purnea town. Geffery in 1768 shewed the river at a short distance east of Purnea, but Rennell found in 1779 that the Kosi had swerved west of Purnea. The Kosi has since worked westwards, across about 50 miles of country, as indicated by now deserted river beds, its flood now touching the borders of Supaul. The Ganges formerly had two channels, one northern and another southern between Sikrigully and Rajmahal, as clearly indicated in Van den Broucke's map. The northern channel was occupied by the Kosi and its mouth moved from Comitpur to opposite Rajmahal. Later on the Kosi adopted the Nepal-Colgong channel. Now the confluence of the Kosi and the Ganges is at Naugachia, the river working havoc over a considerable tract in Bhagalpur on account of its most remarkable meandering. Thus the main stream of the Ganges would no longer pass the head of the Bhagirathi, which was finally reduced to the very minor stream which Rennell found it a century and a half ago.¹

Changes in North-east Bengal. The Atrai and the Karatoya were ancient river systems parallel to each other from north to south.

In the 15th and 16th centuries a new channel of the Ganges, the Padma, collected the drainage left by the western detour of the Kosi and curved to the north forcing her way successively along such channels as the Ichhamati, the Chiknai and the Baral rivers. One of these channels of the Padma meeting the Karatoya at Handiaal is indicated in Van den Broucke's map.

The Atrai river whose importance is shown by its retaining its name in Rennell's map right from north to south then deflected eastward due to the movement of the Ganges.

The old channel of the Atrai-Tista is discernible in Rennell's map XII. Martin in his survey of the Upper provinces of Bengal which was undertaken in 1810-11 notes the importance of boat traffic on the Atrai which was carried on throughout the year. The river has, however, deteriorated rapidly since then due to the alteration of the course of the Tista and most of the marts mentioned by Martin have disappeared.

The Karatoya formerly brought the combined waters of the Tista and the Brahmaputra as the Jamuna does today. Bakhtiar Khilji found this river thrice the width of the Ganges. The Karatoya (Caor) has given the name to the entire course of the Brahmaputra in the maps of De Barros and Cantelli da Vignolla. The recent course is well charted by Van den Broucke and described by another Dutchman, Valentine (1726). In the 18th century the Karatoya was cut in two by the main Tista of Rennell's time. Rennell saw the Tista at a transitional stage since the main stream of the river then was taking the course of the Atrai on its way to join the Ganges instead of joining the Brahmaputra. Martin found that the Tista has increased greatly in size since Major Rennell's survey and observes: "The Tista is called also Yomuneswori. The latter name seems to be the most proper, and the name Tista seems to have been given to it, since the greater part of the water of that river has been d'verted to this channel, which happened in the year 1787-8."

The silting up of the upper course of the Brahmaputra, the deflection of its course through the Jamuna channel, the enlargement of the Tista and the deterioration of the Atrai and the Karatoya and their branches,—all hang together, ultimately linking the north-eastern Bengal river system with the Brahmaputra system. New linkages are still being created and consolidated; while the connections between the north-eastern Bengal river system and the Ganges system are

being choked and cut off. Land-building is proceeding with phenomenal rapidity in the north-eastern and south-eastern tracts. The prosperous areas on the more considerable rivers of the past, on the other hand, are gradually being converted into a dead river zone. Several smaller rivers which were formerly flowing south-eastward show a more and more marked westward trend of which the best example is the Kaligunj river. Fed by the floods of the Padma, Atrai and the Jamuna some of these rivers, unlike the decayed rivers of Central Bengal, meander a great deal.

The upsetting of the North Bengal drainage system is marked also in the silting up of the Chalan *bil* as well as other depressions, and of the many interconnecting channels which are in consequence liable to sudden inundations.

The Tista-Jamuna system will in future be building a new delta on an old delta, and the entire area will be intersected by silted-up rivers, *bils*, ridges and river-beds and subjected to recurrent local floods and drought.

Changes in Western Bengal. In 1658 the Damodar met the Rupnarain at a distance from the estuary and the combined channel (the Patraghata) flowed eastward to unite with the waters of the Saraswati and the Bhagirathi. One of its branches, probably the parent of the Banka, followed an easterly course near Burdwan and joined the Bhagirathi at Ambowa. Another branch flowed into the Bhagirathi at Satgaon. In 1773 the Damodar made a detour to the west and joined the Bhagirathi due south at Gewankhally. In Rennell's time the Damodar was navigable as far as Burdwan. The Banka in Rennell's map met the Bhagirathi much further up at Merzapur. The Banka, the Behula and Kana Damodar have all silted up.

The Ajay, an important navigable river in 1658, met the Hughli at Udhanpur (Thana Ketugram) and not at Catwa as in Rennell's time. Both the Ajay and the Mayurakshi

have now considerably declined while the waters of the two other western rivers, the Damodar and the Rupnarain, are in large measure lost for the agriculture of Bengal.

Changes in Central Bengal. With the eastward trend of the Ganges the Saraswati began to decline from the middle of the 16th century, until now it is hardly recognisable as more than a tiny, weed-grown creek. In the maps of De Barros and Blaeu, the three rivers, the Saraswati, the Jamuna and the Ganges (the Bhagirathi) are shown in almost equal thickness. The Saraswati passed Satgaon and Chouma (Chaumaha in Hooghly district) and the Jamuna flowed westward to Barham (Booroogram in Jessore). (J. R. A. S., Vol. XLII, 1873.) The Jamuna does not figure at all in Van den Brucke's map. In Rennell's map the Jabuna leaves the Bhagirathi opposite the old offtake of the Saraswati river, and the name persists from the Bhagirathi to Savashpur on the Icchamati. The missing portion in Rennell's time was linked up by the Icchamati. The name Jabuna is continued in Khulna district to the sea-face.¹ The Bhagirathi then rose into prominence along with three other rivers, the Kumar or the Bhairab and the Icchamati.

Within the next few centuries a few more rivers emerged in Central Bengal as a result of the invasion by the Brahmaputra of the Gangetic territory, and these brought about the ruin of the older spill channels of the Ganges. The Kumar was beheaded by the Chandna and the Barasia, the Bhairab by the Jelanghi (emerging about the 15th or 16th century), and the Icchamati by the Mathabhanga. In Rennell's time all these rivers were practically dry in summer though not in all places.

The latest river to emerge in the western delta is the Gorai-Madhumati which similarly was the outcome of the impact of the Brahmaputra on the lower reaches of the

¹ See Hirst's *Notes*, p. 99.

Padma after its accession of strength from the Tista-Jamuna system. This river emerged sometime between 1820-1830. Fergusson writing in 1863, spoke of the possibility of the expansion of the Mathabhanga and the possible danger arising out of the Hughli deserting Calcutta. It is no longer the Mathabhanga but the Gorai-Madhumati which is, however, the most active delta-building river in this region, the Brahmaputra acting as a natural barrage to the waters of the Ganges.

But though the Gorai-Madhumati has now served as the most important outlet for the waters of the Ganges in the Central delta at the expense of many older rivers and channels of Jessore and Khulna which have decayed, the eastward march of the Ganges continues. Thus the hope that the Jessore or Nadia rivers may again revive in the struggle between the Ganges and the Brahmaputra which Fergusson entertained, is left unfulfilled. A Committee on the Hughli River and its headwaters, presided over by Stevenson Moore, also came to the conclusion that the Ganges spill channels pass through successive phases of deterioration and improvement and that there is no definite evidence of their permanent deterioration. Many decades have passed since the eastward march of the Ganges began and the rivers of Central and Western Bengal show no tendency to revive after completing their supposed cycle.

On the other hand, the silting up of the Murshidabad, Nadia and Jessore rivers has been accelerated in recent decades, and land formation in the central delta is being completed resulting in the obstruction of drainage and water-logging over two-fifths of Bengal. The rivers are choked with weeds; the *khals*, pools and depressions no longer serve as natural drainage reservoirs and channels, but are converted into breeding grounds of anopheles, the subsoil water-level is rising and the moist jungle spreading

on all sides : these have persisted with an agricultural decadence unprecedented in the world.

Development in Eastern Bengal. The Brahmaputra till the 14th century was entering the Bay near Chittagong.

As the river subsequently turned into the swamps of Sylhet due, according to Fergusson, to the upheaval of the Madhopur jungle, the Surma which formerly flowed from Manipur due west turned southward and became the parent of the Meghna river.

Fergusson describes the subsequent progress of the struggle between the Brahmaputra and the Meghna and between the Brahmaputra and the Ganges. In the first struggle the Brahmaputra lost and retraced its steps seventy miles northwards and found a channel for itself above Dewangunge in the bed of the Jamuna. This defeat had been preceded by the Brahmaputra successfully following three courses in the past between Dacca and Sunarampur, marked by the respective beds of the Lukya, the Little Burrampootry and the Burrampooter creek. All these old channels lie in the sphere of area of the highland on which Dacca stands and which has been gradually elevated by the river itself. Hirst observes : " Outliers to the main block of high-land spread as far east of Dacca as the Little Burrampootry river."

The Padma system of rivers which includes the Ichhamati, Dhaleswari and the Buri Ganga flows from north-west to south-east with a strong tendency to alter the direction from west to east.

The Brahmaputra system of rivers flows from north to south with the exception of one river, *viz.*, the Dhaleswari, which after the irruption of the Brahmaputra through the Jamuna channel is now completely cut off from the Padma system and since then has tended to adopt a direction from north to south.

Between the Padma system and the Meghna we have a continuous struggle, the clear waters of the Meghna tending to block up the channel by arresting the Padma silt. Ascoli traces this struggle thus: "By the year 1830 the Meghna had arrested the north-east tendency of the Padma, which was compelled to find a more southerly channel; by 1840, however, the north-west tendency has again arrested itself, only to be defeated again about the year 1870, to such an extent that the former main channel of the Padma was often fordable between 1873-1883. By 1893, however, the Padma again resumed the attack, and it is only in recent years that the Meghna has come out victorious and is driving the Padma into a more southerly channel."¹

The Struggle of the Two Mighty River Systems. In the lower delta the struggle of the rivers whose vast volume of waters is pressed between the Madhopur jungle and the Tippera hills on the one hand, and the upheaved tracts on the other, is reflected not merely in the changes of the position of confluence of the rivers and shifts of their courses but also in the capture of tributaries. The Dhaleswari and the Buri Ganga have been captured by the Brahmaputra system, while the streams which now unite to form the Meghna were doubtless, before the eastern subsidence, tributaries of the Brahmaputra. The Meghna rivers are now following a 'dog in the manger' policy. The Khasia hills are relatively bare and in the rainy season record a fall of 500 to 600 inches of rainfall. Thus the waters of the Meghna group of rivers though considerable possess little or no silt. Accordingly swamps cannot be filled up by them, while they have turned back the only river which could have done this, viz., the Brahmaputra. The result is that "as the delta extends,

¹ Ascoli: *Settlement Report of Dacca*; also his article on the Rivers of the Delta, J.A.S.B., November, 1910. The description of the river system of Dacca given here has been freely utilised.

the land between them and the sea, below Dacca, must rise, and the rivers consequently must deepen and their water spread." The defeat of the Brahmaputra system at the hands of the Meghna has aggravated the danger from storm waves and inundations in the lower deltaic districts. On the other hand, the Brahmaputra, now reinforced by the Tista and united with the Ganges, has renewed its attack against the Meghna through the Kirtinasa. In the battle area as the mighty rivers shift by cutting their own banks or by gradually entering into and opening out the banks of smaller streams, riverine marts and villages are exposed to a swift and wholesale destruction unparalleled elsewhere.

Though the battleground has shifted from the old junction of the Brahmaputra and the Meghna in the east to the Rajnagar area, it appears so far that despite the coming into the attack of an additional adversary, *viz.*, the Ganges, the Meghna is again proving victorious.

Changes of Confluence of the Rivers. The following table will indicate the changes of confluence of the Ganges, Brahmaputra and Meghna :—

Period.	Place.	Source of Information.
14th century.	The Ganges and the Brahmaputra (the Jun or Jamuna) unite close by Chittagong (Sudkawan), "a large town on the coast of the great sea," and discharge together into the sea. The Meghna (the Blue River) also descends from Kamarupa and is used by travellers to Laknaoti. Ibn Batuta himself and later on Fitch (1586) came up the Meghna and Ganges from Chittagong and visited Sonargaon, the ancient Muhammadan capital of East Bengal on the river.	Ibn Batuta (1225-1354).

Period.	Place.	Source of Information.
16th century.	The Brahmaputra (R. Caer) meets the Ganges at Bander or harbour (Sripur in Dacca district). Several islands including Sandwip and Jugadia are indicated on the mouths of the rivers. The route from Chittagong to Gaur is through Sonargaon (Sernagram) and Dacca (Daca). The only other ports of importance in Bengal, besides Chittagong and Sripur are Pipli (Pipli patam). Chandecan and Saptagram (Satigram). Another main river is the Saraswati which is indicated as diverging from the Bhagirathi near Saptagram and passing through Chaumaha and Mandaran (in Arambagh subdivision in Hooghly district) to re-unite with the channel near Bator. Three confluences were, then, important in the 16th century : Sripur (at the confluence of the Brahmaputra and Ganges) Satgaon and Bator (both at the confluence of the Saraswati and Bhagirathi).	De Barros' map of Bengal (1550).
17th century.	Four estuaries are mentioned. "The Ganges discharges its voluminous, rapid and wholesome waters by four vast mouths into the Gangetic strait." These four estuaries are probably those of the Rupnarain (Ganga), the Ganges, the Brahmaputra and the Meghna.	The Manrique (1649).
	Three rivers, the Lakshya, Brahmaputra and Dhaleswari (which represent the course of the Ganges at Dacca) meet at Katrabe and the combined waters unite with the Meghna (the Boom river) a little beyond to the east. An island is formed, on the north of which is Sonargaon and on the south are Idrekpur and Sripur. South of the Dhaleswari is another channel of the Ganges, probably the Kali Ganga, the precursor of the Kirtinasa. Peter Heylyn also describes Sonargaon on an island in the main channel of the Ganges. From the west comes the Icchamati to join the main channel of the Ganges at Idrekpur.	Valentine and Van den Broncke's map of Bengal (1658-1664).

Period.	Place.	Source of Information.
	Bikrampur is bounded on the east by the Brahmaputra and on the west by the Ganges. The Brahmaputra courses through the channel marked by Agrasindhu. Langalbandh and Kamalapur and occupies a portion of the channel of the Meghna, east of Vikrampur.	The Maya Chandrika quoted in J. M. Roy's <i>Daccar Itihasa</i> .
18th century.	The Brahmaputra (Laquia) and Meghna meet towards the east of Dacca. One of the channels of the Ganges courses through Dacca and meets the Brahmaputra before the latter unites with the Meghna.	Herman Moll's map (1710).
1770	The Brahmaputra and Meghna meet near Sunerampur and Nursingdy east of Dacca district. The Ganges and Meghna meet near Dakhin Shahbazpur island in Bakarganj district, although from Goalundo (Jaffargange) downwards there are connections between the Ganges and Meghna, these being best typified by the Dhaleswari. South of that river the Ganges and Meghna gradually converge and here and there are connected by cross-streams, running from west to east. "But it should be noted," observes Hirst, "that the Ganges and Meghna's main streams never join, or at least their waters do not fully merge, until after each has reached the coast."	Rennell (1764-1776).
	The Icchamati joins with the Dhaleswari and the combined waters join the Meghna opposite Naraingunge.	
	Both the Lakshya, the old course of the Brahmaputra, and the Dhaleswari, the old course of the Ganges, have greatly declined in importance, and the main channel of the Ganges after the impact with the Atrai-Tista on the north courses to the sea from further west.	

Period.	Place.	Source of Information
	Thus the confluence of the Ganges and Brahmaputra has shifted much further west to the south since the 17th century.	
1787	During the floods of 1787-89 some of the offshoots of the Brahmaputra develop into the Jamuna and the main river coursing through the channel of the Jamuna joins the Ganges near Goalundo. We have evidence of two marked stages of the incursion of the Brahmaputra into the Jamuna channel. The first stage is represented in Rennell's map (1776) where though the main course of the Brahmaputra flows eastward through Mymensingh to the Meghna, several important streams are charted, leaving the Brahmaputra near Dewanganj and flowing southward. The Tista-Atrai itself also flowed into the Ganges river near Rottingunge. The second stage in the transition is described by Buchanan Hamilton in 1805. "The Konai (the Jamuna) is of great size and formerly went with a winding course into the Natore district, but between the towns of Bhabaniganj and Dewanganj the Brahmaputra has made an irruption and has carried away a great part of its channel. In return the Brahmaputra gave a large supply of water to the lower part of the Konai which now passed behind Dewanganj scarcely inferior to the mighty river, and threatens to sweep away the whole intermediate country "	
1793	In this year a new and large river, the Naya Bhangini, breaks through the isthmus of Srirampur.	
1794	The mingled waters of the Ganges and Brahmaputra cut across Vikrampur through the channel of the Kirtinasa and complete the process of destruction by 1818 Ascoli traces from old correspondence of the Board	

Period.	Place.	Source of Information.
	of Revenue the mention of Naya Nadi Rath Khola (the real name of Kali-ganga) or Kirtinasa in 1794, indicating the relation between the opening up of the new exit to the Meghna with the abnormal flood of 1787.	
1809	The island at the confluence of the Buchanan rivers disappears. Sonargaon is Hamilton-gulfed.	
1870-1880	The Ganges in the south deserts the Ariakhan bed and moves eastward. Rajnagar is destroyed in 1871-72, and Luricule or Sherpur Feringhi in 1880 together with the <i>math</i> at Japosa.	
1910	The confluence of the Ganges and Meghna is about $23^{\circ}20'$ N. or a degree further north than it was in Rennell's time. The old channel now known as the Ariakhan, enters the Meghna at about $22^{\circ}40'$.	T.H.D. La Touche (Memoirs of the Asiatic Society of Bengal, Vol. III, 1910-14).
1935	Great changes have taken place in the areas of the confluence in recent years. A vast series of <i>chars</i> or sandbanks, showing the old course of the river, now extend southwards. The Naya Bhangini, although a most recent channel, is showing a strong tendency to silt up. This is due to the success of the Meghna in damming back the Padma some twenty-five miles to the north at Rajbari and compelling it to deposit its silt along the west bank of the Meghna. So extensive are the <i>chars</i> thus formed that they have thrust the mouth of the Naya Bhangini so far south as to make it appear as a feeder of rather a dependent on the Meghna. The Ariakhan, another new and uncertain channel has changed its course completely over a long reach. "Of the 250 sq. miles in this area," observes Ascoli, "not twenty can claim	
		Ascoli's Settlement Survey.

Period.	Place.	Source of information.
1935	<p>continuous existence since Rennell's day, the changes in this area are as rapid as they are extraordinary." There is another noteworthy difference since Rennell's time. The area is no longer "thinly inhabited" or "little cultivated." Chandpur, "a small but remarkable village," has become an important railway town. While the old solid block of land on the south-east of Bakarganj district has been cut up into fragments, the series of massive <i>chars</i> shown in Rennell's map, have now consolidated into the immense island of Bhola, and there is continuous erosion now going on in the Noakhali bank of the Meghna, reforming the estuary in the easternmost or Sandwip channel.</p>	Ascoli's Settlement Survey.

Causes of River Change and Development. The above brief survey of the changes of river courses and development and decline of rivers in Bengal clearly indicates that it is the rivers of Northern Bengal, carrying the drainage of the Himalayas and the vast accumulations of water during the monsoon in the *terai*, and flowing into the Ganges and the Brahmaputra, that are chiefly responsible for mighty events in the Bengal delta. The natural course of the Ganges after it has swept past the Rajmahal hills is to flow southward to the Bay along the channel of the Bhagirathi or any other river in Central Bengal. The Himalayan river, Kosi, which is known to have been of the greatest importance in ancient times and which once flowed into the Lohitya, took a westerly direction some four or five centuries ago and in the reversal of natural drainage that ensued in North-western Bengal the Padma emerged, cutting across in Akbar's time Rajshahi and Pabna districts, and while its main current flowed by its northern bank, the Bhagirathi and the other Nadia rivers declined. As the north-eastward pressure of the Ganges continued the Jessore rivers began also

to decline in the subsequent decades. Similarly the advent of the Jamuna after the floods of 1787 when another Himalayan river, the Tista, abandoned its old bed was chiefly responsible not only for the deflection of the Brahmaputra, but also for the emergence of the Kirtinasa and the Naya Bhangini in the lower delta in the south-east. The Tista grew into importance on account of the decline for over a century of the Karatoya which formerly was as mighty a river as the Ganges and which drained off the mingled waters of the Tista and the Brahmaputra as the Jamuna does to-day. The development and decline of the North Bengal rivers thus have determined the trend of the Ganges, and latterly of the Brahmaputra. Seismic disturbances are violent in Northern Bengal and Assam and it is these which brought about changes in the Kosi, Mahananda, Atrai, Karatoya and Brahmaputra. It is well known that the earthquake of 1897 caused many minor streams in Nepal and North Bihar in or near the Siwaliks to change their courses and speeded up the deterioration of the Karatoya. More than a century before this the earthquake of 1762 is held responsible for the deterioration of certain important feeders of the Kosi river and its consequent detour to the west. This earthquake and a few centuries before this the upheaval of the Madhopur jungle and subsidence of the eastern tract extending up to the Sylhet swamps had also contributed in large measure to the alternate westerly and easterly trends of the Brahmaputra, which as it flowed through the modern Jamuna probably advanced to the territory of one of the larger rivers, all the land between the Barind and the Madhopur jungle being alluvion or recent formation. Surveyors may throw light on the possible changes of the North Bengal rivers by measuring the amount of depression now going on in the earthquake zone as well as the levels of the watercourses and especially the heights of the

depressions in the mountains above the present courses of the streams within the hills. Next to the seismic changes, the recurrent floods due to the heavy rainfall in the sub-Himalayan and Assam tracts which the North Bengal rivers cannot control in their beds are the cause of river changes. Such were the phenomenal floods of 1787-89 which led to changes in the Brahmaputra river system, caused the Kirtinasa to engulf an important part of old Vikrampur in its onrush towards the Meghna and Naya Bhangini to cut open the isthmus separating the Arialkhan and the Meghna. The floods of 1774-1776 similarly caused havoc in Western Bengal and provided the river Damodar an opportunity to forsake the uplands of Burdwan and to press southward to mingle with the Rupnarain near the estuary. Deforestation in the catchment areas of the rivers of Northern and Western Bengal in the Himalayan and Chota Nagpur ranges, the silting-up of *jheels* in Sylhet, Jalpaiguri and Dinajpur lead to the shrinkage of the river's domain, meandering or decline. Such Chota Nagpur rivers as the Ajay, Mayurakshi and Dwarakeswar, not to speak of the Damodar, and all the rivers of Northern Bengal have wandered a great deal, and the areas traversed by these are now intersected by deserted river-beds and *bils*. Vast changes in the accumulation of snow in the upper Himalayas and the diversion of the waters through canalisation in the United Provinces and Bihar cause changes in the volume of water and oscillations of the Ganges. The distance which a river traverses before it mingles with another river or falls into the sea, the slope of the plains, the amount of silt which it carries, the obstruction which it meets from swamps or lowlands on its way, determine the success or failure of a river in capturing another river's territory. The present struggle, for instance, between the Ganges and the Brahmaputra for the territory west of Barind and east of the Madhopur jungle and their respective share in re-sculpturing the delta west of the

Meghna estuary will be determined entirely by the above physical factors.

Rivers form an Inter-connected System. Finally, river systems are linked with one another in an interlaced, integral whole. The decline of one river is followed by the rise of another if land-formation remains uncompleted. The activity of one river and the increase of its oscillation or disparity of current in one bank or the other deflects the courses of the tributaries that flow into it. An example of the former is the supersession of the Karatoya, a mighty river till the 17th and 18th centuries, by the Tista and Jamuna. The latter's invasion has led to no great disturbance of the natural drainage of the eastern parts of Rangpur, Pabna and Bogra, while several meandering rivers of the tract that find mention in Rennell have merged in it. Similarly the Gorai-Madhumati came into existence on the decline of several spill channels of the Ganges in Central Bengal, as its activity has also led to the further decay or capture of many old rivers by it. On the other hand, the impact of the Jamuna and the consequent pressure of the Ganges are mainly responsible for the vigour of the Gorai, the country west of it being already raised and consolidated by old and settled rivers. Examples of the latter are the westward deflection of the rivers of Pabna such as the Kaliganj river due to the activity of the Jamuna, and southward deflection of the Dhaleswari which has changed its allegiance to the Ganges for the more vigorous Brahmaputra.

Artificial Interferences. Artificial works such as the construction of railways and roads, bridges and embankments, the silting up of marshes and the premature reclamation of low lands for cultivation also affect the natural drainage, bring about changes in annual floods and disturb the entire river system. A deltaic river languishes or dies from the operation of the same forces

which brought it into existence, but man's artificial interference with drainage and river and his encroachment of the river's territory bring about premature senility and death. We have already seen that a deltaic river periodically oscillates between its permanent channel and its offtakes into which it usually splits up. The life-history of a deltaic river constitutes, indeed, a continuous diversion of channels and formation of branches, such branches again dividing themselves into sub-waterways and similarly showing changes of their regime. The deterioration or death of some waterways and improvement or emergence of others are thus essential features of a deltaic landscape. When due to the unfavourable position of its offtake as a result of the main or the deep channel of the parent river having oscillated on to the other side, a branch river is in moribund condition, it becomes relatively easier to bridge it with bridges of insufficient spans, build causeways with embanked approaches and reclaim its margins for cultivation. Such artificial interferences cause a moribund river to dwindle all the more and finally to change to a chain of stagnant pools or meres. Cultivation is not only restricted to the banks of the dying rivers but also extends to the river-beds. Such reclamation of the banks and beds of the lower reaches for agriculture effects an easy adjustment of the river in its new regime through the reduction of the channel section. Again such methods of fishing as 'bitties,' 'kumars,' 'pallas,' 'bars,' 'doars,' etc., have contributed not a little to speed up the death of rivers after these had been languishing. Finally, marginal flood embankments meant to protect riverine villages and towns, roads and railways lead to the deterioration of rivers by facilitating the deposition of a portion of silt-contents within the river-beds. With the gradual rise of the river-beds there is race between the flood level and the embankment. The process of siltation within the narrowed river channels is accelerated; while the

dangers of breaches of long lines of earthen embankments to the entire countryside become more and more serious. Man's artificial actions and lack of foresight have often induced conditions being created on a waterway which prevents its assuming its normal regime when the parent river oscillates back to a position favourable for its development.¹ For the same reasons an active river that makes and remakes the landscape can be settled in its course in the plains by bridges and embankments only after several tentative attempts. The site of a mart like Sirajgunge or a railway terminus like Goalundo has shifted like the *chars* of the Padma many times during the last half a century, and even the future of the Hardinge Bridge is uncertain due to the river twisting its course. The Padma's oscillation, the amount of silt it carries, the slope of the plain, the resistance it meets from the land and the waters from other rivers and marshes are factors over which man has hardly any control; and it is these which determine whether the river will erode a particular bank, and destroy man's handiwork bridge, embankment or town, or change its direction by gradually entering into a minor stream and widening its banks in a manner that will render it difficult to recognise its old bed after a few years.

The ancient and modern vagaries of the Padma. The Padma shifts her course especially violently in the area where she encounters the resistance of the silt-laden Brahmaputra, while the changes that the estuary undergoes towards the east are forestalled by the changes in the position where the Padma and the Brahmaputra meet. At least the following ancient confluences seem to have been located. The Chalan *bil* in the Natore subdivision, Rajshahi, and the Arial *bil* in Dacca mark the old junctions of the Ganges and the Brahmaputra in successive epochs in the past, and the

¹ Man Singh : Note on the Flushing of Old Rivers.

morass in Barisal, which on Rennell's map is described as impassable by land in most parts, that of the Ganges with the Meghna. In the past Vikrampur was the most important seat of settlement in the east, and was studded with Sanskrit schools and colleges. Capital cities such as Rampal, Sonargaon, Rajnagar, Sripur, Katharab, Khizirpur and Kowar-Sunder arose in successive epochs in the region. Formerly both the Dacca and Faridpur districts were the most active centres of deltaic land-formation. Now, with the old age of the river Padma and the advanced formation of its alluvium, the centre has shifted to Bakarganj and is shifting to-day to Noakhali. In the eighteenth century the Ganges occupied roughly the bed of the present Arialkhan and the Brahmaputra joined the Meghna in Sylhet. The combined waters of the Meghna and Brahmaputra swept to the sea under Noakhali and it is probable that their western bank was unbroken land from Vikrampur to Mehendiganj and from Mehendiganj to Sahabazpur, both of which latter are now more or less islands. At that time the Ganges flowed somewhat parallel on the other side of this shaft of land. At their mouth was the island Sandwip, the abode of the Portuguese pirates, which was described by a Venetian traveller as one of the most fertile places in the country, densely populated and well cultivated. In 1625 Herbert described it as one of the fairest and most fruitful spots in the whole of India. About 1730 the Brahmaputra and the Meghna swung westwards and flung out a channel which cut through the shaft of land separating them from the Ganges, joined the Ganges, and twisted its course from south-east to south. Miles and miles of land were added then to the sea-coast of Noakhali, and a great part of Sahabazpur was destroyed. Further south the Bakarganj coast was swept away, to reform rapidly as a chain of islands on the eastern side of the river. In 1744-66 the Ganges joined the Meghna at a point near Mehendiganj in the district

of Bakarganj, more than 45 miles in a straight line south of the present junction. In 1794 it joined the Meghna in close proximity to its present junction under the name of the river Kirtinasa. This was due, as we have seen, to the diversion of the Brahmaputra. In 1765 the Brahmaputra joined the Meghna at Bhairab Bazar. In 1790 the Brahmaputra circumvented and joined the Ganges near Jaffarganj in Dacca, instead of near Mehendiganj in Bakarganj. The Padma has shown a continuous tendency to cut towards the north and east. This north-east tendency has had its effect at the junction with the Meghna, whose clear waters at the same time, by arresting the Padma silt, have tended to block up the channel. By the year 1830 the Meghna had arrested the north-east tendency of the Padma which was compelled to find a more southerly channel; by 1840, however, the north-east tendency again asserted itself, only to be defeated again about the year 1870, and so decisively that the former main channel of the Padma was often fordable between 1873-83. By 1893, however, the Padma again resumed the attack, and it is only in recent years that the Meghna has once more come out victorious, and is driving the Padma into a more southerly channel; at every such attack it appears that the mouth of the Padma moves further north. These changes have also been felt in the estuary. The main current has turned eastwards so that the western channel, the Ilsa Tentulia, has begun to shoal. In the meantime, however, the chain of islands on the west has joined on the Sahabazpur. Thus this island, which was once destroyed, has been remade, and is a prosperous settlement. Great silt-deposits have also formed land rapidly to the south and east of that island. The Settlement Officer of Bakarganj writes after his survey that it is probable that Mehendiganj and Sahabazpur will soon again be joined together by a shaft of land and that the Arialkhan will decline into one of the great internal rivers of Bakarganj. Whether it will still carry enough

silt to consolidate the islands at its mouth into a compact block of land, or to extend the southern coast of Sahabazpur, is not so clear. On the eastern side the Sahabazpur channel has been destroying Sahabazpur and consolidating Hatia for 15 years. As the land forms off Mehendiganj, the current should set further eastwards, ceasing to vex the limits of Bakarganj and beginning an era of violent reconstruction in the estuary south of Noakhali.

Future of the Eastern March. The eastern march of the river still continues. It is a far cry from Midnapur to Noakhali, from Sagar to Sandwip. But the same rivers which at first made their way to the sea at the extreme west of the great bend which marks the northern limit of the Bay of Bengal, have now concentrated their attention towards the eastern bend adjoining the Chittagong sea-coast. On the west coast of the delta the tides rise twelve or thirteen feet, on the east from forty to eighty. On the west the water is salt enough for mangroves to grow for fifty miles up the Hughli ; on the east the sea-coast is too fresh for that tree for ten miles south of Chittagong.¹ Westward the country is full of the memory and marks of ancient sea-ports and sacred river-beds which have been deserted in the eastward movement. Westward we have decadent agriculture and dwindling population ; in the east we have phenomenal agricultural prosperity and expansion of population in a country which but lately was a muddy expanse with no trees or shrubs but what were being planted. The movement is gradual but inevitable. Man is powerless to deal with the stupendous forces which the great rivers bring to bear on the land. The land-formation and re-formation must go on, and the intervention of man can make no difference. It is estimated that if a fleet of 2,000 ships, each freighted with 1,400 tons of mud, were to sail down the river every hour of the day for four months

¹ See Hooker's *Himalayan Journal*, Vol. II, p. 390.

continuously, they would transport to the sea a mass of solid matter only about equal to that borne down by the Ganges in the four months of the flood season. Where rivers are active in their delta-building functions, alluvion and diluvion, with changes in the course of the main channels, wait for no man. Having completed the silting up and land-formation of the northern and western part of the delta, the great rivers are now swinging eastward in the estuary south of Noakhali and west of Chittagong. Already the Tentulia channel of the Meghna has shoaled largely and it is the least active of the Meghna's distributaries. Similarly the Meghna river on the west of Noakhali is also studded with sand-banks. According to Beveridge who wrote in 1876 English-built ships never ascended the Meghna, but sloops from Chittagong sail up it in the cold weather to Narainganj, and also cross over to Dakhin Sahabazpur loaded with earth oil and also bringing away in exchange cocoa and betelnuts. The Meghna appears now to concentrate its activities of land-building to its easternmost or the Sandwip channel on the Noakhali coast. The mainland of Noakhali is accordingly gradually extending seawards and has advanced appreciably during the last half a century. Land-formation has been almost completed in the Bakarganj area of the Sundarbans and in the tract of the Sundarbans between the Jamuna and the Harin-gkata, the rivers have gradually raised the level of the land and reclamation has proceeded apace with the change in the riverain landscape. It will take more than a century to build the mainland of Noakhali and rebuild the islands of Hatia and Sandwip. To-day the most active and violent of the Meghna channels is that which flows between Sahabazpur and Hatia. There is another furious current which will play a prominent part in the remaking of Sandwip and the Chittagong coast. As the forces of the formation of alluvium stabilize themselves and the rivers cease to meander in Dacca and Bakarganj, the towns of Munshiganj, Narayangunj, Chandpur and

Jhalakati will leap into prominence. In the meantime the formation of sand-banks in the lower reaches of the Hughli will make it less and less adapted to the requirements of ocean traffic and navigation which Calcutta satisfies today. Perhaps Port Canning might appropriate to some extent the maritime and commercial activity of Calcutta and prolong the fight with unfavourable deltaic conditions. Thus the Sahabazpur river or the Sandwip channel will probably take the place of the Hughli. Sandwip and Chittagong may revive, not as abodes of pirates who ruined and laid waste a large portion of Lower Bengal, but of merchants who will open out new sources of wealth for the people. The building of the spacious bridge across the Padma at Saraghat and the recent selection of Chittagong as a first-class port are noteworthy steps towards this consummation. But the rivers build or destroy in decades, not years; and, by the time the eastern part of the bend eclipses the glory of the western, the rivers in the upper reaches, in their uninterrupted course of land-building, will have destroyed many of the cities and villages which now adorn their banks by withdrawing waters from them and scattering life and prosperity in new directions. The river makes or unmakes land, and with it man and his works, throughout its course. Its powers of building or destroying are, however, mightier in the delta than in the upper reaches and in an extensive plain where it has undertaken a long arduous journey these are simply stupendous.

CHAPTER X

SILT AS THE TRACK OF CIVILISATION

Early Man and the Himalaya. Ages past the central Tethys sea covered the area now occupied by the whole mountain system of the Himalayas and the Indo-Ganges plain. Marine deposits containing Nummulities have been discovered in the Himalayas raised to an elevation of 20,000 feet within the Tertiary period ;¹ while a marine fauna has been recently found near Omaria in Rewa, Central India, which has hitherto been regarded as only continental in origin. But Gondwana land moved against Asia crumpling up the rocks of the Tethys and underthrusting itself beneath them. Geologists attribute to the movement of Asia and Gondwana land towards each other the uplift of the Himalayas and its immediately associated ranges and the down-warping of a portion of Gondwana land on which the Indo-Gangetic alluvium was laid in geologically recent times. They are also of opinion that some of the granites of central Himalaya and border ranges close to the peninsula were intruded in pre-Triassic times and belong to pre-Himalayan tectonics, though they are probably of more than one age. It is clear also that there are a number of granites in the Himalaya of different ages. It is recently suggested that there is an Aravalli structure in the Himalayas north-eastwards from Delhi and this has received considerable support from the gravity investigations of the Survey of India, which suggest that there is an upward buckling of the floor of the Gangetic trough along a line stretching from

¹ *Imperial Gazetteer*, Vol. I, p. 50.

Delhi towards Saharanpur.¹ The emergence of the Himalayan region was completed only in the tertiary period and as the result the ocean was gradually driven back until in miocene times it was restricted to Baluchistan on one side and Burma on the other. The Himalayan belt, Assam and Burma being lately elevated regions, the rivers here are swift and torrential and the valleys are steep. The Ocean was driven back still farther in pliocene times when the mastodon and other mammals now extinct roamed through the jungles of Burma and the Himalayan foothills, leaving their bones to be buried in the rapidly accumulating river sands.² Before the Tethys Sea completely withdrew and before the Ganges trough was filled up by alluvial deposits, a most significant event in the earth's history took place somewhere in the Siwalik region. It is not improbable, as Prof. Barrell first suggested, that Man and the Himalayas arose simultaneously, towards the end of the miocene period, over a million years ago. Sir Arthur Smith Woodward tells us that "as the land rose the temperature would be lowered, and some of the apes which had previously lived in the warm forest would be trapped to the north of the raised area."³ The shrinkage of the forests compelled man's arboreal ancestors to descend to the open ground, the high plateau and mountains barring their march eastward and westward. As they descended on the open ground the difficulties for struggle for existence which the ancestors of man then experienced were crucial in his emergence. *Homo Sapiens* emerged in the pleistocene age, not later than a million years ago, probably in the Siwalik

¹ West : Some Recent Advances in Indian Geology, *Current Science*, January, 1935.

² *Imperial Gazetteer*, Vol. I, p. 57.

³ Geddes and Thomson: *Outlines of General Biology*, Vol. II, p. 1134 ; Barrell : Probable Relations of Climatic Change to the Origin of the Tertiary Ape-man, *Scientific American*, 1917.

region. That Asia is the birth-place of mankind is seemingly established. That the cradle was perhaps in the Siwalik region seems to be indicated by the physical and climatic conditions of the Siwalik zone during the tertiary era, by the close proximity of the Indus valley civilisation, recognised to be one of the earliest if not the oldest civilisation of the world and by the discovery here of most of man's domesticated plants and animals, and by the evidence of making of necklace and girdle and work on shells and bits of bone which were buried with the dead in addition to weapons, a practice that is usually associated with Cro-Magnon man. Finally, accepting the testimony of the distinguished palæontologist, Professor Lull, "we have to go to the region north and south of the Himalayas to find peoples whose facial characteristics best resemble those of Cro-Magnon man, while the stature and bodily build are best displayed by the Sikhs.¹ Elliot Smith also holds that the common ancestors of anthropoid apes and men probably occupied Northern India during the miocene epoch.² The emergence of *Homo Sapiens* in the same region, due to the mountain barriers compelling new adaptations by preventing rapid migration of man's immediate ancestors, is exceedingly probable.

The Saraswati, the Great Middle Tertiary River. Palæontological evidence indicates that the last phase of the Himalayan upheaval took place subsequently to the lower pleistocene epoch. The emergence of the modern Ganges and its flow eastward belong to the newer pleistocene and recent age of geological history. In the Indus or Ganges valley, man fifteen thousand years ago was still in the palæolithic age. Civilization in the sense of social life based on agriculture

¹ Lull : The Antiquity of Man in *The Evolution of Man*, edited by Bartsell.

² *Early Man* : Lectures delivered at the Royal Anthropological Institute, p. 3.

and metal-working dates back to less than ten thousand years. Thus the Siwaliks are contemporaneous with man ; but both the Ganges and the formation of its vast alluvial surface date subsequent to him. Important changes are believed to have taken place in the main drainage lines of Northern India so late as the Middle Pleistocene, *i.e.*, an epoch of time later than the emergence of man. A great middle tertiary river, called the Siwalik river by Pilgrim and the Indo-Brahm by Pascoe, succeeded the eocene gulf of the Tethys Sea that withdrew after the first phase of the Himalayan upheaval. This river then carried the combined discharge of the Brahmaputra, the Ganges and the Indus, and flowed north-west throughout the entire length of Northern India. It is probable that the Bay of Bengal had extended northward to Assam rather than the eocene gulf of Northern India extended so far eastward.

In the final phase of the Himalayan upheaval differential earth movements elevated the Potwar Basin in the north-west Punjab into a plateau. The north-west section of the great Indo-Brahm river was now converted into an independent drainage basin with the Sutlej as its most easternly tributary. At the same time the remaining upper portion of the same channel was subjected, according to Pilgrim and Pascoe, to a process of reversal of flow, its water seeking an outlet along the now aggraded, more or less submontane plains. Visser has suggested that all the three rivers, the Brahmaputra, the Ganges and the Indus, which all take their rise in the older mountain ranges north of the Himalayas and break through the Himalayas by tremendous gorges, are all older than the Himalayan range. With the periodic uplift of the Himalayan chain which rose exceedingly slowly the rivers had time to make their beds and courses through the new region. " They eroded their beds during the million and million of years that the mountains were rising higher and higher, while the gorges in the meantime were becoming deeper

and deeper.”¹ Whether the Ganges was older than the Himalayas or not, it is certain that the severed upper part of the Indo-Brahm river became the modern Ganges, having in course of time captured the transversely running Jumna which represented the channel of the Indo-Brahm and converted it into its chief affluent. Wadia describes the next process thus: The transverse Himalayan rivers, which are really the oldest water-courses of North India, older in many cases than the mountains they traverse, continued to discharge their waters into this new river, irrespective of its ultimate destination, whether it was the Arabian Sea or the Bay of Bengal. During the upper pleistocene epoch some interchange took place between the easterly affluents of the Indus and the westerly tributaries of the Jumna, by minor shiftings of the watershed, now to one side now to the other. There are both physical and historic grounds for the belief that the Jumna, during early historic times, discharged into the Indus system, through the now neglected bed of the Saraswati river of Vedic traditions.² The channel was through Eastern Punjab and Rajputana, and is now occupied by an insignificant stream which loses itself in the sands of Eikaner desert. The Saraswati is described as consisting of five river systems in the Yajurveda, and of seven rivers in the Mahabharata which also definitely mentions that the river met the sea in the west in Prabhash.³ It is probable that Pilgrim's Indo-Brahm river is the Saraswati with its five streams as mentioned in the White Yajurveda which together with the Ganges and the Jamuna made up the ancient sevenfold river system in Aryan India. In course of time the Saraswati

¹ A letter from Visser to the late Sir Devaprasad Sarvadhicary.

² Also Fergusson: Delta of the Ganges, *Quarterly Journal of the Geological Society*, XIX, 1863

³ The Mahabharata, Vanaparva, Section 82

took a more and more easterly course and ultimately merged into the Ganges at Prayag. It then received the name of Jumna.¹ It is interesting to mention that while the Vedas describe the Indus, the Sutlej and the Saraswati systems as flowing into the sea, such mention of the Ganges and the Jumna taking a seaward course does not occur. On the other hand, in the Mahabharata we read that the Ganges flows into the sea after uniting with the following seven streams: the Jumna, Saraswati, Sutlej, Apaya, Sarju, Gumti and Gandak. A comparison of the Vedic and the Epic rivers gives clear evidence of river capture.

Stages of Siltation and Settlement. From the delta of the Ganges to the delta of the Indus a low flat country extends, built up by pleistocene alluvial deposits which have completely buried past geological records. Borings in the Gangetic plain have all failed to reach the rocky bottom; while on the surface the vast alluvial plain does not show even a pebble to disturb its monotony. As we go farther and farther towards the east the older alluvium gradually passes into the new till we reach the Ganges delta where the existence of beds of peat composed of forest vegetation and rice plants and lignite below the surface is an evidence of depression within prehistoric and even historic times. Not merely the Sunderbans but the entire Gangetic delta has undergone a general subsidence. The average depression of the Gangetic delta is estimated at 18 to 20 feet since the land surface existed which is marked by the occurrence of *sundri* trees. The depression was uniform and everywhere more rapid than would be compensated for by the deposition of sediment, the upper strata, though full of fragmentary plant remains and

¹ Wadia: The Tertiary Geosyncline of North-West Punjab and the History of Quarternary Earth Movements and Drainage of the Gangetic Trough. *Quarterly Journal of the Geological, Mining and Metallurgical Society of India*, Vol. IV, No. 3.

sometime freshwater shells, showing no land surfaces. The western portion of the Bengal delta is fringed by Chota Nagpur plateau, a fragment of Gondwana land, from which several rivers swoop down into the ancient channel of the Ganges. This portion of Bengal was first built up by the deposition of silt by rivers draining Gondwana land and was one of the earliest seats of settlement and civilisation in this delta.

Long before man was born the mighty Indo-Brahm river travelled to its confluence in the north-west carrying the drainage of the entire northern India. As the mighty rivers were depositing their rich silts vast changes came upon man due to climatic causes and the abandonment of hunting and nomadic life in an extensive pene-plain. It is not improbable that the strength and life which the rivers added to man helped towards his transition from the paleolithic age to the age of metals, tools and crops. Since the geological era in which occurred the parting of the waters, when the Indus affluents first started westwards, and those of the Ganges first turned eastwards, the variety of climate and physical conditions of the two basins left its deep impress on man's physical characteristics and culture. It appears that the more spacious valley in the east was always attracting races and peoples from the north-western basin. In historic times the mighty river Ganges, scattering in her south-easterly course wealth and strength, has been the major route of migration and settlement of invading races and cultures. The existence, especially in the north-western mountain ranges, of gaps called passes caused by faulting and river erosion has profoundly affected the history and civilisation of the Indian plains. From the Indus plain to the plains of the Jumna and the Ganges the road lies between the desert and the mountains, and is rich in memories of ancient decisive battles which governed the destiny of Hindusthan: Kurukshetra, Thaneswar, Panipat.

The British Army traversed the same track beaten by adventurers, conquerors and empire-builders in previous ages when it conquered the Punjab and, again, when it conquered Delhi from the mutineers. Delhi, the central city of Hindusthan, the imperial city *par excellence*, the cradle and grave of successive empires, lies towards the south-east on the same track, the natural site of an imperial capital and the centre of the struggle for the empire. "For Delhi," observes the geologist Fermer, "is at a point where the plains of the Indo-Gangetic alluvium that separate the Peninsula from the Himalaya become most constricted, the point consequently at which it is easiest to defend the fertile plains of the Jumna and the Ganges to the east against invasion from the west, the direction from which most of the major external invasions of the past have come."¹

Links between the Ganges and Indus Valley Civilisation. Recent excavations at Mohenjo-daro and Harappa have revealed that the Indus valley civilisation was highly elaborate and urban and had its connections with the neighbouring civilisations in Sumeria and probably also extended itself into the Ganges Valley through the track of Delhi and the eastern corridor of the upper Ganges-Jumna Doab. In the regions towards the east there are fertile valleys, where the pastoralists could find ample and spacious pastures for their flocks and herds and the peasants some of the most productive fields and crops. Throughout the Ganges Valley we now find evidences of the cults and customs of the Fertile Crescent as well as the Dravidian language that the civilised inhabitants of the Indus Valley had brought to the banks of the Ganges and the Jumna and thence to the far eastern borders. Terra-cotta figurings of the mother Goddess have

¹ Presidential Address at the Twentieth Indian Science Congress, Patna, 1933.

been excavated in Bihar not dissimilar to those from Mohenjodaro and Crete. These were found at a site fifty-two feet below the earth's surface and thirteen feet below the Mauryan strata. Social anthropologists can point to this as a clear evidence of the extension of the Indus Valley civilisation to the Ganges Valley and the Madhya Desa. Similarly, the cult of the bull and the snake, megalithic monuments and marriage customs, not unsuggestive of Babylon and of fertility rites which are Phaphian, all seem to indicate the infiltration into the broader plains of the Ganges of the social and economic order associated with the temple city and culture on the Indus that in its turn looks for its origins to a common racial and cultural background, Mediterranean and Armenoid. On the evidence of Indian skulls Sewell and Guha establish that "it would seem probable that the Mediterranean stock had become established in Northern India at a period that clearly antedates the civilisation at Nal and along the Indus Valley, and the differences that have been shown to exist between the human remains at Anau, Kish and Nal indicate that a sufficient length of time had elapsed for certain local variations to have become evolved and established."¹

The Pre-historic Peoples of the Ganges Valley and their Chief Contributions. The Ganges Valley was, before the advent of the prehistoric peoples that built up the civilisations of the Euphrates, the Tigris and the Indus, the home of the Proto-Indics or Proto-Australoids and of the Munda language. These were the great prehistoric people in the east with their original home probably in the Ganges Valley and Western Bengal whence they had spread to Polynesia. Sanskrit literature described them as the ancient Nisadas, Bharatas and Savaras who are mentioned even as far back as in late Vedic times. The former were gradually driven into the Vindhya region where they became the parents of the Bhils

¹ *Excavation in Baluchistan*, p. 80.

or Bhillas. They are not to be found now in the Ganges Valley although, according to the Ramayana, they had a kingdom in the heart of the Ganges Valley whose capital was Srīngaverapura on the north side of the Ganges opposite Prayag.¹ Oppert suggests the connection of the Bhars with Barhai of Ptolemy and with the Bharatas, who were probably a mountain folk in ancient times. Another hypothesis is that the Bhars may be an offshoot of the Mediterranean stock, Abheras. According to the epics the Abheras migrated from Aparantaka or Western India while the Puranas refer to their settlements both in Northern and Southern India. The Abheras were worshippers of Krishna, who, as Slater aptly observes, "was of Nag descent and the traditional blue colour in which Hindu art depicts him possibly represents the brunette colouring of the Mediterranean as distinguished, on the one hand, from the blonde Aryans and on the other from the dusky aboriginals."¹ Finally, a distinct tradition in the United Provinces indicates that the Bhars after their expropriation were reduced to the present Ahirs, which is the Prakrit form of Abhiras and who in tribal groups are now found in large numbers in Rajputana and the United Provinces, Nepal, Bihar and Bengal. The Savaras are identified with the Suari of Pliny and the Sabarae of Ptolemy. It is believed that though now separated and confined to the jungles of eastern Malwa or Bundelkhand they once occupied large portions of the Ganges Valley up to the borders of the Jumna-Chambal system and stretched across the Peninsula to the north-east of the present-day Madras Presidency. They were formerly the dominant branch of the great Proto-Indic (Kolarian) peoples who were in occupation of the northern Gangetic plain. They have now passed into oblivion, and possibly merged into many lower castes.

¹ B. C. Law : *Ancient Indian Tribes*, Vol. 2, p. 62.

The memory and traditions of ancient glory of three ancient peoples are, however, still preserved in the United Provinces. The Bhars were the suzerain for centuries in the Western and Central Gangetic plain, the Cheros in the Eastern plain and the Soeris (the ancient Savaras) occupied the line of hills which rise along the south of the valley of the Jumna and the Ganges. The Census caste table does not always show them. It is believed that the Hinduised tribal caste of Bharia returned from Rewa and other Baghelkhand states are descended from the ancient Bhars. Of the Bhars Crooke says: "The most probable supposition is that the Bhars were Dravidian race closely allied to the Kols, Cherus, and Soeris who at an early period succumbed to the invading Aryans. This is borne out by their physique and appearance which closely resemble that of the undoubted non-Aryan aborigines of the Vindhyan-Kaimur Plateau."¹ There is no doubt that the Bhars were once a widespread race, who ruled a wide tract in Northern India from Gorakhpur to Saugor and Rewa before they were displaced by the Rajputs. They were very powerful in Oudh and in portions of the Gangetic doab.² Numerous old stone forts, embankments, wells, tanks, and subterraneous caverns are attributed to them in the eastern part of the United Provinces. Bennet thinks that the Bhar kings of Oudh once ruled from Malwa to Mirzapur and Fyzabad, with their principal strongholds at Kalanjar and Kara.³ All ancient village sites are ascribed to them; "every town," observes Crooke, "the name of which does not end in pur, abad or mau is assigned to them." As rulers they have probably given the name to Bahraich district, where there are now only a thousand Bhars, now mere serfs. It appears that the Bhars who were persecuted

¹ *Castes and Tribes of the Central Provinces*, Bharia.

² Sherring : *Hindu Tribes and Castes*. The Bhar Tribe.

³ On the Bhars, Kings of Oudh, *The Indian Antiquary*, 1, 265.

equally fiercely by the Muhammadans and Rajputs, (the former calling them "the accursed Bartup") had their last stronghold in the district of Rai Bareli where they were not finally suppressed till the reign of Ibrahim Shah of Jaunpur.¹ They have again a claim to antiquity as a tribe mentioned by Pliny in his list of the Indian races as the following quotation from McCrindle's *Ancient India* as described by Megasthenes and Arrian would show: "There is a very large island in the Ganges which is inhabited by a single tribe called Modogalingae. Beyond are situated the Modubae, Molindae, the Uberæ with a handsome town of the same name," etc. The Modubae (says an explanatory foot-note) represent beyond doubt the Moutiba, a people mentioned in the Aitareya Brahmana along with other non-Aryan tribes which occupied the country north of the Ganges at the time when the Brahmans established their first settlements in the country. The Uberæ must refer to the Bhars, a numerous race spread over the central districts of the region spoken of and extending as far as Assam. The name is pronounced differently in different districts and variously written as Bars or Bhars, Bhowris, Barrilas and Bharhiyas, Bareyas, Baoris, Bharais, etc. The race though formerly powerful is now one of the lowest classes of the population."

The Cheras, who may have been the Cherapadas of the Aitareya Aranyaka, were also a powerful race and were the masters of the soil in the eastern Gangetic plain. Buchanan noticed a peculiar custom among them of appointing a Raja for every five or six families who is created in the Rajput fashion by the application of a mark or *tika* to the forehead. The Cheros seem to have occupied, not merely certain districts of the United Provinces, but also, according to Dalton, the entire Gangetic territory in Bihar south of the Ganges and ex-

¹ *Rai Bareli District Gazetteer*, p. 130.

tending up to the hills, while according to Buchanan Hamilton they extended as far as Kosala in the United Provinces where they are still the strongest in the Gorakhpur and Mirzapur districts.

The Savaras have almost disappeared from the Ganges Valley proper. They are now a small tribe, the Soeri, found mostly in the districts of Benares and Mirzapur. We read in the old district Gazetteer of Benares : " whether the Bhars and Soeris (Savaras) governed side by side or not, or whether they are merely different names for the same race, has not yet been determined. To the south of the Ganges, ruined forts and buildings of undeniable antiquity are universally attributed to the Soeris, and " the accepted history of the settlement of the great Rajput tribe in the tahsil, the Bhrigbansis, specifies the dynasty which preceded them as a Soeri one. If this is the case, their rapid disappearance from the district is curious especially so as the Bhars, a twin tribe, still exists " in swarms all over the country." ¹ From all accounts these people appear to have advanced in their material culture more than their brethren who remained or preferred to remain in the inaccessible hills but they could not withstand the onslaught of the invading Aryans or the later invaders speaking Aryan languages. Their languages were strangled, their culture destroyed and in course of time not without struggles and set-backs on either side, they finally succumbed and perished. ²

Another autochthonous race which came to acquire great political importance was the Kewats or Kaivartas, who are mentioned in the Puranas and who claim their descent from the Nishadas of the Epics. The Kewats

¹ *Statistical Descriptive and Historical Account of the North-Western Provinces*, 1884, Vol. XIV, p. 102.

² Appendix on Migration of Castes and Tribes in Central India and their Distribution. *Census Report of the Central India Agency*, of which I have availed myself freely.

are essentially marsh-dwellers and were dominant probably throughout the Terai region. Even now they are the strongest in the Ganges-Gogra doab and in the Western delta in Bengal where they probably settled after their displacement in the hands of the Rajput adventurers. Their sole representatives in the upper valley now are the Dosadhs, Pasis, Musahars, Doms and other low castes as well as a small dying Munda-speaking tribe, the Korwas, living a precarious existence in the jungles of Mirzapur and Sirguza. Their language, Munda, however, which is their most enduring and important legacy, has survived in Upper India in the Himalayas as far east as Sikkim and as far west as Ladakh, in Chota Nagpur and the west of the Central Provinces and southwards in the Ganjam and Vizagapatam hills.

It is probable, then, that the meeting ground of the two greatest prehistoric peoples of the world, *viz.*, the Mediterranean-Armenoid and the Munda-speaking peoples, was the Ganges Valley. To the former, India in the economic field owes probably her town building, architecture, navigation, the use of coins and the cultivation of wheat: To the latter, India owes her rice culture and irrigation, terrace-farming and the council of the five. India is probably also indebted to the proto-Australoid people for her entire system of agrarian distribution and rural settlement. The common ownership of pasture lands and water-courses, the communal employment of rural artisans and labourers, village and caste government through a hierarchy of tribunals as well as the system of land revenue, all seem to be the outgrowths of early proto-Australoid culture under the conditions of Indian economic geography. The worship of local spirits and the sacredness attached to the earth, fields and trees are also proto-Indic or proto-Australoid features, while the worship of the snakes, the cult of the bull, the worship of Lingam, which are all non-Vedic, have been attributed to the early

culture of the Mediterraneans and Armenoids in India. Another important prehistoric contribution of the proto-Indics or proto-Australoids was the neolithic culture and pottery which was spread throughout the alluvial plain. In the Ganges alluvium in Ghazipur was, however, excavated a serrated fish-bone resembling an arrow-head which was found below a stratum containing polished neolithic tools. The chief localities where the neolithic remains are now found concentrated near the Ganges Valley are Mirzapur, Sirguza, Baghelkhand, Rewah, the Kaimur hills, and the Chota Nagpur plateau. Various kinds of pigmy flints shaped like arrow-heads, crescent or pointed forms have been found embedded in ravines and in shoals on the floors of caves or rock shelters along with the ashes and charcoals of hearth or with entire skeletons and rude pottery. A neolithic sepulchre even was discovered in Mirzapur. The skeleton of an adult male was found with vessels of glazed pottery and glass in a cave, while ruddle or hæmatite drawings showing stag hunts, were found in the Kaimur hills.¹ Three paleolithic implements were discovered in Bengal : a yellowish celt in the village Kunkune in the District of Hooghly, and axes in the Jheriah and Raneeganj coal mines. Neolithic finds which were, as might be expected, more numerous and varied in their nature, were concentrated in the Chota Nagpur plateau and its fringes. Chaibassa, Chakradharpur, Paresh-nath, Ranchi, Hazaribagh and other places have yielded interesting neolithic specimens. In the hills of Sitakundu in Chittagong and in the Assam Valley, neolithic stones bearing evidence of man's use were also found with petrified or fossilized wood or embedded in rocks.² The age of stone was followed in the Ganges Valley by the age of copper and fine celts, harpoons, swords and spear-heads of copper have

¹ Radhakumud Mookerji : *Hindu Civilisation*, Chap. III.

² R. D. Banerjee : *Banglar Itihasa*, Chapter I.

been found in Bijnor, Etawah, Mainpuri, Muttra, Cawnpore, Fatehgarh, Hazaribagh and Midnapur districts, and indeed, all over Northern India "almost from the Hooghly to the far side of the Indus, and from the foot of the Himalayas to the Cawnpore district." Marshall observes that the longbar celts, swords and barbed heads are quite peculiar to the Jumna-Ganges basin, and different from anything known to us either from the Indus Valley or anywhere else. "Possibly these objects give us first glimpse of the Indo-Aryan culture in the Upper Gangetic Valley, but it may be that they represent some culture yet unknown to us of Dravidian or Proto-Australoid origin, and distant alike from both the Indus and later Indo-Aryan culture." ¹

Advent and Expansion of the Rig-vedic Aryans. India was later on the scene of another racial expansion, that of the Rig-vedic Aryan, and it appears that the new invaders were much more warlike than their predecessors and their settlements were rural than urban in contrast to the Indus Valley culture. It was in the spacious plains of the United Provinces that the fusion between the earlier civilisation and the Rig-vedic culture took place. The phases of contact between the Mediterraneans and Armenoids and the Rig-vedic Aryans in the Ganges plain seem to be indicated by two episodes in the Mahabharata. The burning of the Khandava forest in the valley of the Jamuna and the expulsion of the Nagas with their ruler, Takshaka, who had to take refuge in the hills, represent episodes where the two great peoples met in bloody conflict. On the other hand, the marriage of Arjuna with Ulupi, daughter of the Nag King, Vasuki, and of Bhima with Hirimba, daughter of a Rakshasa, represents a significant step towards racial assimilation of the two great peoples in the Jumna-Ganges basin. It is clear that by the time of the Satapatha

¹ Marshall : *Mohenjo-daro and the Indus Civilisation*, p. 107.

Brahmana, the Aryan occupation of the Central Gangetic plains was complete. Already at the time of the later Upanishads, the Himalayas and the Vindhya were regarded as the boundaries of Aryandom, which indicates that the region now known as the United Provinces formed part of the Aryan land.¹ The Satapatha Brahmana also marks the period when the Aryan culture was first spread to Videha by Madhava, the Vaideha. The Aryan settlement of Bengal took place much later, the Aitareya Aranyaka and Baudhayana Dharma-Sutra showing unfamiliarity with the distant peoples of Bihar and Bengal. Even in the time of Patanjali, the Vangas were excluded from Aryavarta.² The country was, however, Aryanised before Manu wrote his Dharma Sastra. For the Manu Samhita (4th Century A.D.) extends the eastern boundary of Aryavarta to the sea. "In early Buddhist literature," observes Law, "where detailed lists appear of many countries and peoples, the Vangas and their country are conspicuous by their absence. They are mentioned, however, in the Jain Prajnapara which ranks Anga and Vanga in the first group of Aryan peoples." On the other hand, 80,000 villages were mentioned in Magadha under the sway of Bimbisara in the Vinayapitaka which also states that the fields were well divided for the purpose of cultivation. Magadhan colonisation thus preceded the settlement of Bengal by at least ten centuries.

Alpine and Mongoloid Migrations. Meanwhile an Alpine stock, probably from the Pamirs, came through the north-western gates of India and thundering past the civilisation on the Indus spread down the west coast of India (the ancestors of the Prabhus and the Marhattas) as well as the Ganges Valley, reaching the farthest eastern borders where the stock appears to be responsible for the broad head and fine nose of

¹ A. Ghosh: *The Original Inhabitants of the U. P.*, Allahabad University Studies, Vol XI.

² Sylvan Levi: *Pre-Aryans and Pre-Dravidians in India*, which gives interesting early references to Bengal.

the Bengalis. In Bengal, according to Guha, the main concentration of the brachycephalic Alpine type is in the southern or deltaic region with gradual decrease towards the north and the east. This outward thrust leading to the colonisation of the delta was no doubt due to the incursion of the Vedic Aryans. Physical anthropology indicates that such great cultivating castes of the United Provinces as the Kunbis, Kurmis and the Kapus represent a distinct Alpine element much more limited in the eastern than in the western portion of the Ganges basin.

Finally, through the eastern gates of the Himalayas and the Brahmaputra Valley have filtered Mongoloid elements. The Mongolian tribes are now chiefly found in the Brahmaputra Valley and the outer borders of the Chittagong Division. The Khasis and Syntengs in Assam, the Lepcha and Bhotia groups in Northern Bengal and the Chakmas and other tribes in Chittagong, all differ little in physique from their Tibeto-Burman-speaking neighbours. The influence, however, of the Mongoloid strain, on the population of Bengal and Northern India generally is now considered to be doubtful, though it was believed at one time that this was responsible for the transformation of the 'Dravidian' long-headedness into broad-headedness in the Mongolo-Dravidian Bengalee. Hutton thinks, however, that the physical type of the Moslem cultivator in Eastern Bengal is strongly suggestive of a mixed Mongolian and proto-Australoid strain. The Mongoloid cast of physical features also crops up unexpectedly with fair frequency in Northern India, particularly along the foot of the hills. One of the Mohenjo-daro skulls has been identified as definitely Mongolian, and from the lowest stratum of the excavations have been recovered terra-cotta figures with unmistakable Mongolian features. Languages of the Tibeto-Chinese family as well as certain Sakti cults and rituals have been also introduced into the eastern part of India by the Mongoloid migrations and contacts.

Racial and Cultural Fusions. In the great plains it proved difficult to maintain purity of blood or to lay stress on colour and race elements. Hindu epic literature clearly shows some of the Rishis and their descendants as non-Aryans indicating that racial admixture extended to priest-hood as it probably did to all other classes. Both in the Buddhist literature as well as in Manu-Samhita we find abundant references to Vratya and Vrisala castes which no doubt represent tribes and clans aboriginal and foreign as have become partially or wholly Aryanised. In Manu's scheme the aboriginal races mentioned as Vrisala are the Khasas and Draviras. The former are hill tribes of the north and mentioned also in the epics and Puranas. In the Mudra-Rakshasa these comprise one of the confederacy of Mlechcha tribes who took the field against Chandra Gupta Maurya. The Khasas are probably the Cesi of Megasthenes and are to-day represented by many septs, both Rajput and Brahman, (Khasiya) in Kumaun and Nepal.¹ The Draviras are of course the Dravidians. The rest of Manu's Vrisala group are the Sakas (Scythians), Yavanas (Greeks), Pallavas (Parthians) and Chinas (Mongolians). Other historically important foreign tribes and castes that we find in the Puranic lists are : the Bahikas, Haihayas and Huns. The evidence is quite clear that when any of the invading or aboriginal tribes could succeed by the power of the sword, they usurped the social rank and title of Kshatriya or Rajput ; while the rank and file were transformed into tribal castes such as the Gujars, Jats, Ahirs and others. Thus within the modern Rajput and Chattri castes we find a number of aboriginal and foreign tribes absorbed ; the assimilation of foreign invaders such as the more civilized Sakas, Kushans, Pallavas and Huns was even easier.

With the Muhammadan invasion and conquest the movement of both aboriginal as well as Rajput or semi-Hinduised superior tribes under the Muhammadan pressure assumed a

¹ Blunt : *The Caste System of Northern India*, p 136.

critical phase. In the search for new territory and in the displacement of peoples, many military aristocratic tribes lost their kingdoms and were degraded into lower agricultural castes; while many groups of adventurers usurped the title of Rajputs with their kingdoms. Fictitious descent was traced to remote ancestors who probably figured in the Puranas and this indirectly contributed towards the process of assimilation by racial admixture, while for many expropriated tribes who lost their social rank the amalgamation with superior social groups was excluded. The result of such admixture are thus summarised by Hutton: "In the United Provinces the population from Brahmin downward is predominantly dolichocephalic, but as the Mediterraneans were no less dolichocephalic than the proto-Nordic Aryans, the Armenoid admixture being probably slight, their fusion with the Indians would not be traceable in the cephalic index, though it would tend to a substitution of dark hair and eyes for the fairer colouring of the Aryans. The element of brachycephaly introduced by the Alpines would be again modified in the direction of dolichocephaly by the newcomers, and it is thus that we find in all the castes of Bihar a higher degree of brachycephaly than in the United Provinces where the Rig-vedic Aryan element is the stronger. On the other hand, the platyrrhine element indicating the proto-Australoid strain is fairly constant in both races and appears with little respective variation in the two provinces, for instance, in the cultivating Brahmins or the Kurmis, though the cephalic indices differ considerably. Thus in Risley's arrangement by nasal indices (People of India, Appendix III, summary of measurements, Aryo-Dravidian type) the castes of the United Provinces and Bihar appear almost alternately, but if the series be re-arranged by cephalic indices the Bihar castes fall into a separate group of 74 and over. Risley's apophthegm that the nasal index indicates the social precedence of any caste was true enough, but he failed to distinguish between the proto-Australoids,

the true aborigines of India, if it be correct that their characterisation was in India itself and the Mediterranean, likewise dolichocephalic but leptorrhine not platyrrhine, who seems to have introduced civilisation and the art of working in metal".¹ In the compact and self-sufficient village communities which dotted the valley along the chiefriver route, stocks and cultures came to be welded together. The increasing pressure of population on the soil also encouraged social cohesiveness. Thus ethnic and cultural disparity was subordinated to economic solidarity and a strong priestly or land lord class was absent in the region which was essentially an area of development by constant impingement and contact. Epic literature gives us the story of the conflict between the Brahmins and Kshatriyas and the extermination of the latter by Parasuram. This perhaps represented a revolt against Aryan aristocracy led by a priestly caste of pre-Aryan and mixed origin which would naturally have the support of the people in general. Even in the present classification of the castes in the United Provinces if we look to the order of social precedence we will find that leaving aside some Brahmin and military aristocratic castes, the rank of any caste as high or low depends upon whether the occupation represented by the caste belongs to an advanced or backward stage of culture and thus economic history affords the chief clue to the gradation as well as the formation of castes in Upper India. Further, the eastern districts of the United provinces observe a sort of hypergamy with the western districts, the reasons being that the higher sub-castes live in the west, and the lower in the east,² and there has been greater racial admixture as we proceed eastwards.

Tribal Solidarity among the Ruling and Land-holding Communities. Thus we find that the caste system differs in its elasticity among the upper and the lower communities.

¹ Hutton: *Census of India*, 1931, p 460.

² Blunt : *The Caste System of Northern India*.

Among such peoples as the Rajputs, Gujars, Jats, Banjaras, Bhars and Ahirs, the castes are of tribal if not national type. The strong military aristocratic traditions of these communities prevent an easy assimilation into the Brahmanical ideas of caste. Tribalism instead of caste solidarity serves here as a most effective social tie. The agrarian distribution among such ruling and superior peoples is strongly permeated by tribalism. We come across such clan or tribal divisions as *pargana*, *tappa* and *tarf* which represent well defined natural divisions held by the brethren of a single tribe. The *thok* is a sub-group which usually becomes the administrative village and this again is subdivided into *pattis*. Such are the *bhaiyachara* village communities which have still survived, especially along the rivers in the upper Ganges-Jamuna doab, and in these compact tribal rural settlements we often find that the lands of the clan area, the *thok*, are made up by taking a part from each different soil area and scattered over the whole *tarf* so as to secure equitable distribution. Tribalism is thus entrenched by communal tenure, and the maintenance of common wastes and pastures, by the juridical traditions of the *panchayat*, which shape village customs and village husbandry and by the maintenance of common tribal funds. In the compact Jat or Rajput communities in the upper doab the large proportion of the villagers possess right of ownership. While there are strong kin feeling and strong attachment to the soil the average size of the holding is, however, much larger, and the average family in the rural area much smaller here than in the eastern districts of the United Provinces where the tenures being the result of expropriation of some ancient race, such as the Bhars, Pasis, and Cheros the proportion of the middle class and of tenants and agricultural labourers is much larger. The eastern districts contain also a large proportion of the more fecund agricultural tribes and castes, and overcrowding,

fractionalisation of holdings and lower standard of living have all gone together.

	Average holding.	Average persons per house.	Average houses per sq. mile.
Indo-Gangetic Plain, West	6·7	4·7	115
Indo-Gangetic Plain, Central	4·7	4·5	122
Indo-Gangetic Plain, East	4·7	5·2	143

Their Caste Exclusiveness, an Accretion to Tribalism. It is thus that in the upper doab strong tribal solidarity and a high sense of honour, which prevents the peasantry to accept the lower standard of living of the eastern districts, have prevented an uneconomic decrease in holdings. A larger proportion of the rural population is also engaged in trade and industry than in the eastern districts, while a great many of them are also soldiers. But if ancient tribal traditions have proved their worth in the modern economic regime, the caste system has also been utilised for maintaining the sense of pride of race, collective solidarity and the standard of living. Often the communities lose their localism and tribal institutions, and supersede the tribal arrangement by a caste organisation with strict endogamy and hypergamy that protect the stocks against all possible forces of admixture of contact. All these have proved economically valuable except when a false sense of prestige and dignity of labour prevent the Rajputs and Brahmins, for instance, from driving the plough compelling them to employ hired farm-hands and increasing their costs of cultivation. Such original land-owners and cultivators of the United Provinces as the Ahirs, Bhuinhars, Bhars, Pasis, Arakhs, Cheros and Kallars were expropriated wholesale by different fighting clans of the Rajputs in the 12th and 13th centuries and settled down as mere tenants and farm-hands. In fact the Muhammadan invasion scattered the Rajputs

all over the eastern Gangetic basin, leading to widespread scramble for land and agrarian unsettlement and finally to the establishment of the ruling and superior Rajputs as the landed aristocracy under the reigning sovereigns, the original owners and rulers being reduced to lower or even untouchable agricultural castes. The Muhammadan incursion and conquest, then, were indirectly responsible for caste orientation in the Ganges Valley. In the first place, the Muhammadans scattered the warring Chauhans and the Chandels after completely subjugating them throughout northern India. The latter are believed to have been a Hinduised off-shoot of the Bhars who, as we have seen, at one time ruled Oudh and occupied large portions of eastern India. It will thus appear that the Bhars, whose name history has forgotten, regenerated themselves in the Chandels who overthrew the Parihars, subsequently rose to great fame and left a most magnificent and imperishable monument of their arts and culture in the temples of Khajuraho. Like the Chandels, the Bundelas and Gaharwals are similarly supposed to have sprung from the Hinduised aboriginal elements. The last mentioned clan is associated with the Bhars of the Central Gangetic plain and held the country round about Benares. The rise of such clans and their spread over a large part of Upper India seems to have synchronised with the Muhammadan incursions. Kanauj, which took the place of ancient Pataliputra as the radiating centre of the Gangetic civilisation, "was the great focus from which migrations spread and from these a dispersal of people took place to reinforce the distant colonies and settlements." It is even believed that the functional and occupational castes migrated from Kanauj to different parts of Western and Eastern India.

Such migration involved internecine conflicts and many Rajput clans disappeared altogether while many migrated into the forests, foot-hills and swamps of Bengal and Assam,

and carved out new territories for themselves. In the process of this Rajput dispersal and colonisation for which the devastating blows of Islam in the Gangetic doab were responsible, many autochthonous ruling castes of the valley were dispossessed and enslaved. Thus the Ahirs, Cheros, Khairwars and others were annihilated after an insistent struggle against the Rajput invaders such as the Gaurs, Sombansis, Surajbansis, Chandels, Chauhans and Rathors. The Pasis, Arakhs and Doms who were the sovereigns of the central Gangetic plain before the Rajput immigrations were expropriated. The Pasis, Arakhs and Doms now remain as derelict survivors of owners and rulers degraded to the level of untouchable castes of the United Provinces.

In the scramble for territory which followed the fall of Kanauj and the invasion of Shahabuddin Ghori, the following Rajput clans are discernible as parcelling out fertile areas in the Upper Ganges Valley: the Rathors occupied the Ganges-Jumna doab; the Tomars, Chauhans and Katherias occupied Rohilkhand. The Gaharwars occupied Benares, Mirzapur and the adjoining part of Allahabad; the Monas occupied Bhadoi, north of the Ganges; the Bais, Sonak, Tissyol, Bisen and Nanwak occupied the territory west of Allahabad; the Bias occupied Fyzabad and Eastern Oudh; the Kausiks occupied Gorakhpur;¹ the Sengars, Haihaibans and Karcholias occupied Ballia; and the Dikhits and Sengars occupied the district of Ghazipur. But the Rajput clans went much beyond the plains and penetrated mountain, desert and forest regions whence they dispossessed the primitive tribes. From the 12th century to the days of the Moghul emperors the whole of the Terai became also the scene of similar displacement and expropriation of such aboriginal tribes as the

¹ Crooke: *Tribes and Castes of the North-Western Provinces and Oudh*, p. 485.

Tharus, Bahelias, Kewats and Cherus. Similarly, the Bhils were dispossessed from the Vindhya, and in Chota Nagpur and northern Bengal the Rajputs have remained as conquerors and rulers of the primitive tribes. The Muhammadan conquest, leading to the outward thrust of the vigorous Rajput clans in the quest of settlements, was indirectly responsible for the disintegration of tribal areas, for the disappearance of certain aboriginal tribes, and for the formation of many Hinduised aboriginal castes in the Ganges Valley.

Amalgamation and De-localisation among Lower Agricultural Castes. Agricultural pursuit in the level plains, however, encouraged social assimilation between the rulers and the ruled, the land-owners and cultivators. Thus the tribal and racial castes, common vestigial remains of fighters, conquerors and rulers, are few and far between in the heart of the Ganges Valley. To-day the caste system as a whole has so grown that the dynamical tendencies of amalgamation and assimilation are much stronger than localism and exclusiveness. Among the occupational groups which form the largest proportion of Hindu castes in the Ganges Valley, the common interests which the needs of the occupations create and enforce, have made for union. Function has been so strong a welding factor that sections dissimilar in their ethnic origin or domicile have tended to unite under its influence. Neither hypergamy nor endogamy has been tolerated, and some of these castes possess panchayats whose jurisdiction extends over large areas, an evidence of de-localisation of individuals which surely and inevitably promotes greater social assimilation and leads to broader and wider designations of the groups. Apart from the occupational castes, which have grown as a result of accretions, the mass of agricultural tribes and castes, such as the Chamar, the Musahar, the Dom and the Dosadh, have all grown recently through a process of de-localisation.

Over the entire Ganges Valley there thus seem to be in operation in castes two distinct sets of tendencies :—

1. Among the upper Hindu castes, which pride themselves on superiority of race, colour or enlightenment and traditions of conquest and subjugation, and look upon manual labour and various occupations as below them, hypergamy and an internal differentiation and special grading are to be found, emphasising the separatist aspects of caste and building up a complete organisation of an *imperium in imperio*. Such exclusiveness was no doubt useful in days of turmoil and racial admixture amid a welter of stocks and cultures in different levels congregated together in the narrow routes of migration. Social exclusiveness and localism are sought to be softened by the cosmopolitan traditions of Brahmanical religion, sacrifices and *mantras* as well as by the institution of pilgrimages to the holy places and temples situated on the banks of the Mother Ganges, holiest of the rivers in India.

2. Among the immense number of lower castes the limits of exogamy and endogamy are far less rigid, and there are far greater possibilities of accretion, assimilation and consolidation. Where community of occupation forms the basis of caste division, heterogeneous groups unite under its influence, occupy more or less the same social status, and coalesce latter in the same social group. The lower agricultural castes and communities similarly show strong tendencies towards consolidation.

Contrasts between Rural Settlements in the Upper and the Lower Valley. Such contrasted caste tendencies have now produced a striking disparity in the growth of the different castes and communities in Northern India, and will entirely change the social composition and numerical balance in the future. India's autochthonous peoples have been accustomed to live in contiguous huts and villages. In the

eastern parts of the Ganges Valley, where the indigenous elements of population are stronger, not only is population density greater but the villages are more compact and contiguous, and the congestion is much greater.

	Average Number of persons per house.	Average holding.
The United Provinces	4·8	6·7
South Bihar	5·4	5·0
North Bihar	5·4	
North Bengal	5·3	3·4
Eastern Bengal	5·5	

It will be noticed that the size of the family rises as we proceed towards the east where part of the greater density is due to the fact that the average family is larger here than in the rest of the valley. On the other hand, the size of the average holding diminishes due to high density and the existing laws of inheritance, except in the far eastern districts of the delta where the reclamation of fresh land is still proceeding. The contrast between the residential villages in the western and eastern portions of the valley is striking. In the western portions of the plain the villages are mostly closely packed settlements standing on mounds that consist often of debris of former habitations. Instead of scattered homesteads we find here clusters of mud-wall houses grouped round a main street with narrow side lanes. "In densely populated areas the establishment [of a new village is no easy matter and the growing population has to find accommodation by overcrowding the existing houses or adding yet another house to the congested village site." Tribal bonds and the common necessities of defence and management of water supply among people, who belong to traditionally different races, have dictated the grouping of

the habitations in the United Provinces. On the other hand, in the eastern plain and delta the villages are dispersed settlements scattered through the rice and jute fields. In the districts in Lower Bengal, bordering the Bay, there are no village sites, as in Bihar or the north-west, or even in Bengal generally. "Each family lives with its holdings, digging a moat round its ample piece of land and planting a garden of fruit trees to enclose the homestead."¹

The relation between agricultural water supply and mode of rural settlement can be easily gauged from the fact that as we move eastwards to the area of abundant rainfall and flood irrigation, the size of human aggregations diminishes and the ties that bind them together become weaker. When the whole country becomes a vast sheet of water for a considerable time of the year, clustered habitations become exceptions, and little groups of huts are dotted here and there on natural levees or artificially raised sites. There is little of collective life, for the space that intervenes between the scattered huts is generally a swamp across which it is toilsome and difficult to walk.² Large and compact settlements are usually to be found in Bihar and Bengal only on the banks of the rivers, or raised pieces of ground free from floods ; elsewhere there is neither congestion of the village site nor uncleanness.³ The caste factor no doubt also accounts for differences in rural settlement. Thus even in the upper plain the Jat villages in the upper doab are quite different from the village settlements in the eastern districts of the United Provinces. The size of the average holding is larger ; there is less congestion in the village site, and both crops as well as animals are aimed at by an intensive, commercialised agriculture which is far different from subsistence farming. Caste factors determine also the type of

¹ Jack : *Report of the Final Settlement of Backerganj*.

² Beveridge : *District of Backerganj*.

³ O'Malley : *Census Report of Bengal, Bihar and Orissa*. 1911.

habitation of the untouchable and depressed castes, whose detached hamlets are on the outskirts of the villages and on the brink of marshes and depressions. The status of the caste, its traditions of agricultural labour or of military-aristocratic dignity, the kind of agriculture whether subsistence farming or semi-commercialised agriculture, the size of the average field and farm and the natural increase of the castes, all these factors determine the pressure upon the land and on the residential site. From Cawnpore to Faridpur the entire congested plain exhibits a low standard of living, an uneconomical agriculture, and heavy pressure on the land. Here the majority of peasants are working on uneconomic holdings with a cumulatively increasing burden of debt, which saps all initiative. From the central and eastern plain of the United Provinces large numbers emigrate to industrial centres partly within the Province and mostly outside. From the moribund and unhealthy deltaic districts of Murshidabad and Nadia there is also an exodus to the more fertile areas of Malda and Rajshahi. Such migrations, however, cannot be compared with the outward thrust of the migrants from Eastern Bengal as population increases or agricultural conditions become unfavourable, along the course of the Jamuna northwards and thence along the Brahmaputra Valley in Assam up to the sub-Himalayan tracts in the north-east.

Differential economic pressure, conditions of the river system and attraction to industrial centres, mines and plantations have led to shifts of population from one portion of the valley to another. The conditions of increase or decay of the peoples have been governed also by factors of caste and social status. We have seen the contrasted demographic tendencies of the upper-caste and the lower-caste Hindus. The contrast is more vivid between the Hindus and the Muhammadans which dominate the eastern portions of the Ganges Valley.

Contrast between the Sex ratio of the Upper and Lower Communities and River-areas. In the Ganges Valley as we proceed from west to east there is a greater admixture of folks of Austric, autochthonous and Mongoloid descent, and this accompanies a rise of the sex ratio in most castes, high and low. The sex proportion of selected castes in the United Provinces, Bihar and Bengal supplies us with interesting clues as to the decay of the more important Hindu communities, among whom the racial effects of this extremely small proportion of females at the reproductive age are aggravated by the various barriers of marriage imposed by exogamy, endogamy, hypergamy and prohibition of widow marriage.

Number of Females per 1,000 Males of All Ages.

	Indo-Gangetic plain, United Provinces.			Bihar.	Bengal.
	West.	Central.	East.		
<i>Upper Hindu Castes.</i>					
Kayastha	802	819	925	921	901
Brahman	789	894	934	964	847
Rajput	780	850	899	905	Not important.
<i>Lower Hindu Castes.</i>					
Chamar	882	992	1049	1100	Not given.
Dom	899	954	940	Not given	965.

The effect of the regional factor is obvious. Generally speaking the sex ratio is greater in the lower than in the higher Hindu castes, and higher in the same caste as we advance towards the east.

Furthermore, hypergamy is a common tendency among the Hindus, and since in the Ganges Valley the lower castes and the lower branches of castes live in the east and the higher in the west, there is marriage migration of females

from east to west, a fact exemplified in the proverb, "brides from the east and bridegrooms from the west." The law of hypergamy greatly complicates the marriage system of the castes who observe it. Hypergamy amongst groups which are of a rank so low that they find it difficult to obtain wives, produces a shortage of marriageable women, and, consequently, a tendency to neglect the law of endogamy. It also produces a deplorable effect on the age when marriage takes place and on the esteem in which women are held.¹

Lastly, as a result of both paucity of females and adoption of rigid exogamous and hypergamous restrictions as well as strict prohibition of widow marriage, the upper Hindu castes show a general tendency of being gradually swamped by the lower Hindu castes and the Hindus by the Muhammadans as we travel down the Ganges. This will be evident from the following table :—

Disparity of Natural Variation of Advanced and Less Advanced Caste Hindus and Muhammadans in Northern India.

	Total Number (omitting 000s).	Percentage of Literacy of Males aged 7 years & over.	Percentage of Variation. 1901-1931.
<i>United Provinces.</i>			
<i>Advanced.</i>			
Brahman	4,556	29·3	-4·8
Kayastha	479	70·2	-9·3
Rajput	3,757	18·3	-4·9
Kurmi	1,756	5·4	-11·8
<i>Less Advanced.</i>			
Chamar	6,312	·6	+6·4
Ahir	3,897	2·0	+1·3
Pasi	1,461	·5	+17·8
Gadariya	1,021	1·1	+8·6
Lodh	1,099	2·4	+5·3
MUHAMMADAN	7,181	9·7	+7·1
HINDU	40,585	89	+0·1

¹ Blunt : *The Caste System of Northern India*, p. 47.

	Total Number (omitting 000s).	Percentage of Literacy of Males aged 7 years & Over.	Percentage of Variation. 1901-1931.
<i>Bihar.</i>			
<i>Advanced.</i>			
Brahman	2,101	35	+ 19·9
Kayastha	383	60	+ 5·5
Rajput	1,412	21	+ 9·3
<i>Less Advanced.</i>			
Goala	3,455	3·7	+ 10·4
Santal	1,712	1·2	+ 31·9
Kurmi	1,455	9·3	+ 18·3
Koeri	1,302	...	+ 4·5
Chamar	1,296	·9	+ 21·2
Dosadh	1,291	1·2	+ 12·8
MUHAMMADAN	4,284 (including Orissa)	1·0	Age 5 & over. 21·0
HINDU	35,206 ,,	9·9	,, 14·6
<i>Bengal.</i>			
<i>Advanced.</i>			
Brahman	1,447	45	+ 24·1
Kayastha	1,558	40	+ 58·3
<i>Less Advanced.</i>			
Mahisya	2,381	18	+ 21·9
Namasudra	2,094	8	+ 13·3
Rajbansi	1,806	5	+ 4·8
MUHAMMADAN	27,810	6·8	Age 5 & over. + 24·7
HINDU	22,212	16	,, + 11·3

* Between 1881 and 1931 the Namasudras and Rajbansis increased by 33 and 100 per cent. respectively.

Regional and Social Factors in the Sudden Shift in Bengal's Social Composition. The agricultural contrasts between the moribund delta with its lower fertility, its rivers, choked with weeds, its water-logging, its malaria and its spread of jungle and the active delta with its large and sweeping rivers bringing their rich silt deposits in ordered sequence, and scouring and draining the entire spill basin when the floods subside, have entered into the social picture. The rapid change in Bengal's social composition is chiefly due to the decay of the river system bringing into ruin exactly those areas where settlements had been the oldest and where the Hindus, especially the upper-class Hindus were concentrated in the past. But if the river system has decayed in Central, Western and parts of Northern Bengal, it is now building anew the country in the east where the lower agricultural castes and the Muhammadans largely recruited from them are in the majority. It is the Muhammadans rather than the less advanced Hindus in Eastern Bengal, suddenly sprung to prosperity, that have, however, profited more from the exceptionally favourable agricultural conditions. The prosperous conditions of agriculture in Eastern Bengal have encouraged widow remarriage and polygamy among the Muhammadans. They live in small families mainly in the towns in most parts of India, but in the highly productive Bengal delta their large household, joint in food and field labour, has obvious agricultural advantages.

In the new clearings and isolated hamlets in the active delta which are far distant from the rural settlements, the needs of agricultural expansion have fitted exceedingly well with their polygamy and widow re-marriage, which are both unacceptable for the Hindu peasants. In the hamlets that rise and disappear on the shifting sand-dunes of the rivers and are exposed to dangers from storm waves and cyclones, crocodiles and tigers, fevers and brackish waters, cultivation is intermittent and settlement is temporary and precarious.

The Muhammadan custom of adopting more than one and as many as four wives who serve as field labourers in new reclamations contributes towards the success of agricultural colonisation in virgin wildernesses, islands and swamps where the delta-building rivers meet the sea in Bengal. Amongst the Muhammadan males not merely is the proportion married much higher than among the Hindus, but the proportion of widows amongst females is much smaller. The following contrast of marital condition of 1,000 of each sex (all ages) in Eastern Bengal is full of significance.

	Hindu.		Muhammadan.	
	Male.	Female.	Male.	Female.
Married	467	472	507	544
Widowed	45	218	18	123
Unmarried	488	310	475	333

Both polygamy and widow re-marriage chiefly account for the more rapid increase in the Muhammadan than the Hindu population, as noticeable during the last fifty years in the whole of the Ganges valley, especially in the eastern districts where the Muhammadan has increased from 645 to 710 per mille of the total population. Even in areas where there is a general decline of the total population the Muhammadan polygamous household has increased in size and filled the gap left by the declining Hindu castes.

The Hindu is declining in numbers not only in Western and Central Bengal, where the Muhammadan is fast filling up his gap and increasing his proportion, but also in Eastern Bengal where the conditions have proved so favour-

able to the sister community. The following table will illustrate this :

Hindu (per mille).

Decadent Delta

	1891	1901	1911	1921	1931
Nadia	419	406	397	391	375
Jessore	390	387	380	381	379

Prosperous Delta

Dacca	386	373	355	342	327
Bakarganj	316	311	296	287	276

Muhammadan (per mille).

Decadent Delta

Nadia	576	589	595	602	618
Jessore	609	612	619	618	620

Prosperous Delta

Dacca	609	623	640	654	668
Bakarganj	679	683	697	706	716

The reason appears to be that the Muhammadan even in the decadent districts often lives not in the old inhabited sites but in new settlements, which are relatively healthier and certainly more productive. Dietetic and social factors also account for greater resistance to disease. The Muhammadan because he is often a convert from the thorough-bred of the soil shows a higher proportion of females and greater fecundity than the upper Hindu social groups.

Fifty years hence out of ten persons in the fields or city lanes in Eastern Bengal eight would be Muhammadans, one would be a Namasudra and another person a Brahmin, Vaidya or any other caste. For the whole of Bengal for every one upper-caste Hindu, there will be six Muhammadans,

and three less advanced Hindus, a Mahisya, a Namasudra, a Rajbansi or any other caste.

Course of Civilisation Relatively Smooth in the Gangetic Fringes. In a riverain civilisation shifts of culture and prosperity have been recurrent with changes in the river system and in the sub-soil water of the alluvial plain. Ptolemy's geography (middle of the second century A.D.) as well as the records of the Chinese pilgrims, Hwen Thsang (A. D. 629-645) and Fa Hien (A.D. 399-414), both of whom traversed the entire Ganges basin, indicate the vicissitudes of the centres of civilisation situated on the Ganges and its great tributaries. After Hastinapur, the capital city in the Epic period, was swept away by the Ganges, Kausambi (near Allahabad) rose into prominence and became one of the most celebrated cities of India, the capital of Udayana Vatsaraja.

In the Jatakas we find mention of boats going up the Ganges to Sahajati and up the Jamuna to Kausambi, while an inland trade route linked India with Central and Western Asia by way of Taxila and the important cities of the Gangetic basin like Saketa, Sravasti, Baranasi, Kusinagara, Vaisali and Rajagriha with a crossing of the Ganges at Pataliputra. Kausambi was found almost in ruins by Hwen Thsang and so were in ruins both Ahichchatra (near Bareilly), a far-famed city well known in epic and Buddhist literature mentioned by Ptolemy and dating from as early as 10th century B. C. and Champaknagar, the capital of ancient Anga as described in epic literature, and one of the six great cities at the time of the Buddha, situated probably at the confluence of the Ganges and the Kusi (the other five cities being Rajagriha, Sravasti, Saketa, Kausambi and Benares). But Mathura on the Jamuna and Kanauj, the capital of Raja Harshavardhana on the Ganges, were great capital cities which were still flourishing. Similarly, modern Prayag, Benares and Ayodhya (identified with Ptolemy's Sagada and Hwen Thsang's Saketa or

Visakha by Cunningham with the small tract lying around the former city) between the Gogra and Gumti rivers were prospering. It is noteworthy that till the 16th century Prayag, Benares and Ayodhya retained their importance. Prayag was in William Finch's time (1608-11) "one of the wonders of the east," and Benares, "the principal mart of Bengal goods" and Ayodhya was flourishing as one of the largest cities of India in the days of Ain-i-Akbari as in the days of the Buddha.¹ Sravasti, another most famous city, the capital of King Prasenajit (c. 500 B.C.), was, however, in ruins when the Chinese travellers visited it. Sravasti is now known as Sahet-Mahet, the ruins of which are situated on the south bank of the Rapti in Bahraich District. It contained "a few more than two hundred families" when Fa Hien visited it (A.D. 400) and in A.D. 632 it was completely deserted. In Kapilavastu (Basti District, United Provinces), too, "all was mound and desolation" (Fa Hien), but in Kusinagara on the Kakustha, now a jungle, 35 miles east of Gorakhpur, there was "a city where the inhabitants are few and far between, comprising only the families belonging to the different societies of monks." Vaisali, the important city on the confluence of the little Rapti and the Gandak, well-known in epic and Buddhist literature, however, was still prosperous and the region was described as very fertile, abounding in forests. Vaisali is identified with the village of Besarh (Abul Fazl's Berar), 23 miles from Degwara. Thus a few great and important cities in the Ganges-Gogra doab had come to ruin between the Buddha and the 4th century A.D.

Vicissitudes in the Sub-Himalayan Tracts. It would appear that while most of the important cities situated on the banks of the Ganges retained their pre-eminence

¹ See also Chabiani: *The Economic Condition of India during the 16th Century.*

through the ages, the peoples and cities of North Panchala or Rohilkhand with its capital Ahichchhatra, North Kosala or Oudh with its capital Sravasti, the clan country with its important cities like Kusinagara, Kapilavastu and Vaisali, and North Videha or Tirhut with its capital Mithila, have shown great reverses, due probably to the vagaries of the Himalayan rivers¹ that have changed their courses, to the fluctuations of rainfall, and to man's persistent defeats at the hands of morass, jungle, malaria and possibly also earthquake. In the Bengal delta, on the other hand, the capital or commercial cities on the banks of the great rivers themselves have shown the greatest vicissitudes, large and important seats of population and commerce decaying in the course of a few centuries into insignificant villages or even completely forgotten, such as Tamralipti, Karnasuvarna, Mahasthan, Suvarnavithi and Lakhnauti.

Monahan observes : " One has only to think of the ruins of Gaur or Lakhnauti which as late as the seventeenth century was capital of Bengal, with a population, probably, of over a million, or of the present state of the town of Murshidabad, which, in Clive's time, rivalled London in magnificence."

As the Ganges had deserted from age to age, the main channels through which its waters flowed into the Bay, far-famed cities which distributed the rich and variegated produce of the valley far and wide came to decay. Thus it was the successive silting up and deterioration of such Gangetic channels as the Rasulpur, the Bhairab, the Saraswati, the Bhagirathi, the Ichhamati, the Naba-Ganga and the Mathabhanga rivers which brought many great cities of

¹ The river Rohini which served as the boundary between the territories of the Sakya and Kolya clans and the river Kakustha on which the cities of Kusinagara and Pava were situated, disappeared and cannot be traced.

Bengal into ruin. Yet, though some branch or other of the Ganges declined, sea-going vessels could come and ascend the rivers from its mouth far into the interior of the valley. Strabo mentions that vessels from the sea could ascend by the Ganges at Palibothra. This was at the beginning of the 1st century of our era. We read from the records of the Portuguese travellers in the 17th century that the Portuguese frigates were able to ascend the Ganges as far as Patna. This ancient city was built in 483 B.C. by Ajatasatru, contemporary of the Buddha, near the confluence of the greater rivers of upper India, the Ganges, the Son and the Gandak and has seen many vicissitudes, rising layer upon layer on the old ruins, its greater portion being diluviated by the Ganges and the Son in 750 A.D. The Son has now receded some distance away from it.

It would appear that in the entire Gangetic basin while the course of civilisation was more or less smooth and uniform in the riverain lands fringing the main river, the region situated in the north, which were intersected by the Himalayan rivers, have shown great ups and downs through the centuries. The northern portions of Panchala and Kosala, ancient centres of civilisation, fell into decay more than fifteen centuries back. The clan country of the Buddhist period, which also had great days of prosperity, reverted into jungle and morass when Fa Hien visited the area. The country of Kapilavastu, Fa Hien observed, was a great scene of desolation. "The inhabitants are few and far between. On the roads people have to be on their guard against elephants and lions, and should not travel incautiously." Similarly, Videha bounded on the east by the river Kusi, in the west by the river Gandak and in the south by the Ganges, and which, at the time of the Buddha, was a seat of great wealth and prosperity, was full of ruins when Hwen Thsang visited it. Pundravardhana, which was the seat of a flourishing population when Hwen Thsang travelled

through this area, fell into decay by the sixteenth century. In the country of Gaur, Finch found all wilderness and many kinds of wild beasts. In the nineteenth century Bareilly, Gonda, Bahraich have hardly developed and were still dominated by Terai conditions, but Gorakhpur and Basti in the United Provinces and Tirhut in Bihar had a great spell of expansion of agriculture and population. But in Northern Bengal it is only on the eastern side intersected by a new river, the Jamuna, that there have been increase of population and development of agriculture.

Phenomenal Expansion of Agriculture and Population in the Ganges-Gogra and Ganges-Brahmaputra Doabs. Looking back for the last three or four centuries, agriculture and population in the whole of the Ganges basin have shown a very interesting and chequered history. Certain areas have leaped into prominence and prosperity while others which had been wealthy and prosperous in the past are becoming barren and desert-like and are being thinned out in population.

In the Upper Doab canal irrigation has revolutionised agriculture in the 19th century, introducing such commercial crops as wheat, cotton and sugarcane, and superseding such low-grade crops as millets, pulses and barley, but it has contributed to only a small increase in the net-cropped area since Akbar's days. Only Bulandshahr and Aligarh have increased by about two-thirds and one-fourth respectively since the time of Akbar. On the other hand, the eastern districts of the United Provinces and both North and South Bihar have increased their cultivated areas about three, four and eight times respectively. Finch travelling along the Ganges from Jaunpur to Allahabad (1608-1611) traversed thirty Kos "through a continual forest." South Bihar, under the regime of the Sur kings, had greater density of cultivation and population. Even in Akbar's days a bigha near Jaunpur, Benares or Patna yielded twice as much as a bigha in the upper Doab. In Bihar in Akbar's

days the area under cultivation did not exceed more than one-fifth as compared with more than two-thirds of the total area at present. The investigations of Buchanan Hamilton indicate that even by the end of the 18th century herds of wild elephants and buffaloes roamed through the north of Purnea, and some even had made their way to the "woods in the south." Only one-fourth of Champaran was under tillage in 1794 and a great part of the districts of Muzaffarpur and Darbhanga, probably half (as compared with more than 75 per cent. of the present day) was uncultivated. Patna's (Bihar Sarkar) cultivated area in Moghal bighas increased seven times between Akbar and Aurungzeb. Saran's area increased more than ten times and, by the end of the 18th century (1795), its total revenue amounted to more than double the figure fixed by Todar Mal.

The development of such areas, however, was far eclipsed by that of the Ganges-Gogra Doab and eastward by the Padma-Brahmaputra Doab in the 19th century. Babar mentioned masses of rhinoceroses on the banks of the Saru (the Gogra) river. The Mughal Emperors hunted lions, rhinoceroses, wild buffaloes, elephants and leopards in the Chunar jungles, and rhinoceroses and wild elephants were roaming in the jungles of Gorakhpur and Basti right till the middle of the 19th century. To-day about 75 per cent. of the total area of Gorakhpur and Basti is cultivated of which the double-cropped area is as high as about 30 per cent.

Agricultural Decadence, Unprecedented in the Jumna Region, North Bihar and Central and Western Bengal. Such remarkable expansion and prosperity cannot, however, eclipse the tendencies towards agricultural deterioration and rural decay discernible in certain large tracts. There are at least four regions, which were once seats of agricultural prosperity, but where the change of hydrographical

conditions and the river system now foreshadows an agricultural calamity of the first magnitude that requires far-sighted and co-ordinated measures.

In the Agra and Etawah region where in some areas the water level has fallen by 75 feet within the last seven decades and desert plants are spreading, the intense strain on cattle and men and the abandonment of old wells have spelt an all-round decay of agriculture and thinning out of population. Much of the area which represents a compact block shows a decrease both of population and of net-cultivated area during the last thirty years. The change to dryer conditions in the entire region is clearly indicated by the loss of valuable crops like indigo and sugarcane which had been grown until the middle of the last century in Muttra, Etawah, Fatehpur and Allahabad. Such crops now have declined or are not grown at all. Here and there in many tracts or near house-sites ancient stone cane-crushing mills lie half-buried, evidence of a gradual desiccation which has bereft the region of its former prosperity. Such desiccation can only be mitigated by the planting of a chain of village groves and forests and the propagation of suitable defensive vegetation against the encroachment of loose sands, while agriculture may in some measure be restored by the use of hydel power for well-irrigation and the release of canal water for this tract from Upper Doab where well-irrigation as a substitute is feasible.

Such remarkable advance is even far outstripped by the most phenomenal expansion of agriculture and population in the districts of Eastern Bengal. Fitch described Northern Bengal as full of forests "with many buffes and tigers" in his tour (1583-1591). Aurangzeb's sarkars of Mahmudabad and Khilafatabad including Nadia, Faridpur Jessore and Noakhali in the east still abounded with elephants and buffaloes at that period which clearly

indicates that much of Southern and Eastern Bengal was not even reclaimed by the beginning of the 18th century. Bakarganj is for the first time mentioned as a revenue unit in 1658. Large parts of Eastern Bengal, indeed, were full of jungles until the end of the 17th century. During the last half a century Eastern Bengal has almost doubled in population while the percentage of cultivated to cultivable area has reached a phenomenal figure of 90 per cent. in Bakarganj and Faridpur within barely two centuries. Some of the world's highest records of rural aggregation ranging between 2,000 and 3,225 per square mile are reached in Dacca over a compact block which far exceeds even the density of Chengtu in China which does not rise beyond 1,700 to the square mile.

Such high density is supported by phenomenal agricultural productivity based on 4 to 5 croppings arranged in succession with the sequence of the floods as compared with only two croppings in the United Provinces and three croppings in Bihar. The Ain refers to these croppings of rice in the subah of Bengal.

Another important and compact region where a tendency of permanent agricultural deterioration is visible is the northern tract in Bihar, where the vagaries of the Kosi, Kamala and other rivers and the devastating floods and sand dunes that bury whole villages over hundreds of square miles, have now become periodical features. The dependence of large portion of this region on a single rice crop, the irregularity of rainfall and the thrust of population from the heavily populated southern areas aggravate the agricultural uncertainty and cause serious apprehensions. Tirhut is already one of the blackest spots in India's famine map. The most remarkable change in levels caused by the last earthquake and the geological tendencies revealed have now added to the anxieties of an already difficult agricultural situation.

Some areas in North Bihar and North Bengal have now become a network of meres, marshes, ridges and channels which are a legacy of the rivers debouching from the Himalayas and there are devastating floods in the monsoon. Floods which destroy crops, cattle and huts have become recurrent in North Bengal, where the vagaries of the Jamuna and its tributary, the Tista, are driving peasants away into the virgin tracts of Assam. Likewise in the district of Mymensingh in Eastern Bengal the swerving westward of the Brahmaputra, which in the days of Ibn Batuta (1330) met the Padma near about Chittagong, close to the estuary, has caused water-logging, flood and intersection of a district, the most populous in India, containing more than five millions people, by decayed river beds. River erosion and periodical damage caused by floods are responsible for a migration of peasant families into Assam involving about 950,000 persons within the last three decades, a migratory movement which is unparalleled in the world in its push, magnitude and influence.

But the most striking agricultural decadence is that of Central and Western Bengal which had been the zone of a dense population by the beginning of the Christian era, and was quite well known to the Roman, Chinese and Arab merchants and navigators. In Burdwan which till the 18th century was "the garden of Bengal," the cultivated area shrank into half during a period of only 40 years, 1891-1931. During the same period Hooghly showed a decline of about 60 per cent. and Jessore 32 per cent. in their cropped areas. In Nadia there was similarly a decline of cultivated area by 20 per cent. Such decline of agriculture, which is probably unprecedented in the world, is associated with the decay of the distributary river system of the Ganges, the absence of the overflow irrigation, water-logging and malaria over vast areas, whose prosperity was so graphically described by medieval travellers.

In the fifteenth and sixteenth centuries Central and Western Bengal exhibited the greatest spell of expansion of wealth and prosperity. Her shores were then visited by the western and far eastern traders for her varied agricultural and industrial produce such as opium, tobacco, lac, tea and salt and the cloths of silk or cotton, and her art and religion spread to other provinces. In 1570 Saptagram on the river Saraswati was still the far-famed deltaic port of Bengal with many European merchants which dazzled into greater prominence like the flare of a candle just before extinction after the destruction of Gaur by fever (1575) and the consequent loss of importance of Chittagong, described as the Porto Grande of Bengal. But that the Saraswati then had been shoaling was clearly indicated only eight years later by Caesar Fredericki (1578) who anchored at Bator, on the site of modern Howrah, and waited for the full tide. A century later, in 1670, *i.e.*, two decades before the city of Calcutta was founded, Bowrey came to this area, described its many prosperous villages, orchards and fields on the river Ganges and its "many large and fair arms," and referred to the Dutch, English and Portuguese merchants visiting her marts for trade with Europe, Persia, China and South Seas. By this time, however, the Saraswati had entirely silted up and the Bhagirathi, which was the most important spill channel of the Ganges and artery of Bengal had also begun to shoal especially at the headwater reaches. For six years later (1676) Tavernier indicated that the mouth of the Bhagirathi at Suti shoaled compelling Bernier to travel by land: "when the river is low one is unable to pass on account of a great bank of sand which is before a town called Soutigue (Suti)." Other French travellers stated that sea-going vessels could not pass from the Bay of Murshidabad but had to anchor at Triveni (near Saptagram now reduced to an insignificant

place) and merchandise had to be carried in small country boats to the island of Cossimbazar, then the chief silk market of Bengal, and one of the first trading centres where the English established themselves. Just a century later (1776) the Damodar left its old channel which joined the Bhagirathi at Katwa, and swerved to the west, thus sealing the door of Western Bengal. With the next two decades Rennell (1781) and Colebrooke (1797) found that the rivers of central Bengal were not passable by boats throughout the year. By 1870 fever, raging as a virulent epidemic in Nadia and Jessore, the heart of the dead rivers area, and decimating thousands, crossed over the decaying Bhagirathi to Burdwan and Hooghly districts, and made its permanent home throughout this region. The cause of the epidemic fever was thus described in contemporary documents. An engineer, Adley, writing in 1869, maintained that "there is no denying the fact that the water-logged subsoil of villages consequent upon impeded drainage by its roads, railways and embankments has mainly contributed to the generation of the miasmatic poison resulting in the outbreak of the epidemic fever." A physician, Payne (1872), reporting on the Burdwan fever, also agreed that "the cause of the epidemic fever is the gradual conversion of a well-drained healthy and prosperous tract of country into the condition of Lincolnshire fens for many years ago with a subsoil water-logged and exhaling marsh poisons for the population to absorb."

Distribution and Movement of the Principal Agricultural Castes in Bengal. The present distribution and movement of the main agricultural castes of Bengal show certain interesting features of social and environmental adjustment. The Bagdis appear to have been the aboriginal race whose habitat was the area just below the fringe of the uplands of Western Bengal; while the Bauris, akin to the former, had their original home above rather than below

the beginning of the uplands. These latter have now given up cultivation and taken to coal-mining which has recently developed as a most important industry in the region as their traditional occupation. But the strongest caste in Bengal is the Mahisyas, who originally must have been the autochthones of the delta, filling the space between the ancestors of the Bagdis just below the fringes of the rising ground to the west and the ancestors of the Pods and Namasudras nearer the delta face. As the deltaic area arose out of the sea, the first persons to penetrate its swamp and forests were the latter races, the Pods extending the frontiers of cultivation first in the southern delta along the Adi Ganga and the Jamuna, especially the 24-Parganas and Khulna, and the Namasudras in the more recently reclaimed south-eastern delta along the Bhairab and the Padma. Although their homes of migration have been different, they have lived amicably side by side. Thus for instance, in the same district, *viz.*, Khulna, the Pods as they expanded downstream chose the course of the great delta-building river, the Jamuna, while the Namasudras chose another important river, *viz.*, the Bhairab. The present caste distribution in Khulna illustrates this.¹ The Namasudras seem to have settled early in the swamps of the east, for as early as 1872 they numbered 326,775 in Bakargunj and 271,335 in Jessore (where the old Bhairab flowed) but only 46,056 in the 24-Parganas ; while the Pods were practically absent from the districts of Eastern Bengal and numbered 249,075 in the 24-Parganas and 21,562 in Jessore, the two districts adjacent to the old Jamuna course. It is rather striking that the Bagdis have increased the least, concentrated as they are in the unhealthiest strip of area in Bengal, while both the Pods and Namasudras have expanded phenomenally. The Rajbansis,

¹ Fawcus : *Settlement Report of Khulna District.*

who come next to the Mahisyas and Namasudras in their total strength in the Province as the third largest Hindu caste, appear to have been the aboriginal race of Northern Bengal, and these continue to thrive but not as much as the marsh-dwellers in the more recently reclaimed zones of settlement.

Caste.	Habitat.	Net Increase 1901-31.
Bagdi	75 per cent in Western Bengal ; strongest in Burdwan ; the remainder in Central Bengal.	2·8
Mahisya	Scattered throughout Bengal ; strongest in Midnapore, Howrah, Hooghly and 24-Parganas.	21·9
Pod	84 per cent in 24-Parganas, Khulna and Jessore.	43·7
Namasudra	More than 50 per cent. in Bakarganj, Faridpur, Khulna and Jessore and strong also in the neigh- bouring districts of Tippera, Dacca and Mymensingh.	13·3
Rajbansi	90 per cent. in Dinajpur, Rangpur, Jalpaiguri and Cooch-Bihar.	4·8 ¹

Distribution and Movement of the Upper Castes. The high-caste Hindus of Bengal settled mainly along the banks of all the ancient active rivers, while the agricultural castes lived mainly in the intervening marshes and jungles to the south and south-west, although colonies of the latter were invited to settle in the outskirts of the villages to supply labour in the fields. As successive races have invaded Bengal, and occupied the comparatively high lands on the fringes of the rivers, the descendants of the aboriginal races gradually extended the frontiers of cultivation to the southern

¹ Thompson : *Census Report of Bengal*, 1921, Chap. XI, and Porter : *Census Report of Bengal*, 1931, p. 492.

and eastern swamps and forests until to-day these represent the majority in the lower delta, which is the healthiest and most productive area in Bengal. The high-caste Hindus, the Brahmans, Baidyas and Kayasthas, though scattered throughout the Province, represent 5 or more than 5 per cent. of the total population in the following districts: Bankura (11 p.c.), Howrah (10 p.c.); Burdwan and Chittagong (9 p.c.); Dacca, Mymensingh, Faridpur, 24-Parganas (6 p.c.); Birbhum, Midnapore, Jessore, Khulna, Tippera, Noakhali (5 p.c.). They represent less than 2 per cent. of the total population in these districts: Rajshahi, Dinajpur, Jalpaiguri, Rangpur, Bogra, Malda and Cooch-Bihar. Paundrabardhana including Barind was an important seat of Aryan occupation of Bengal, but it appears that the establishment of the Muhammadan power with its headquarters at Gaur, Pandua and Tanda may have driven the ruling Hindu races from this region.

In ancient times the Aryans hardly penetrated into the north-eastern districts of Bengal. Kankagrama bhukti comprising Murshidabad (4 p.c.), Birbhum (5 p.c.) and probably also Nadia (5 p.c.) still show some strength of the ruling races, but the largest is shown by Burdwan, Hooghly and 24-Parganas (ancient Bardhamana bhukti) as well as by the districts of the lower delta, which remained the last strongholds of Hindu defence and independence even after the establishment of Moghul supremacy. Vikrampur and Jessore, where the Bara Bhuiyas, amongst whom those of Sripur, Bhuluah, Chandradwip, Jessore and Bosnah were Hindus, fought the last fights of the ruling Hindu races against the Moghuls, still show a considerable proportion of the better class Hindus. In the same district the numerical preponderance of a particular high caste can be explained by medieval political history. Thus in Bakarganj the Kayastha domination is partly due to the fact that the Chandradwip Rajas were Kayasthas, while the large number of Baidyas is

to some measure due to the prominence in the 18th century of Raja Raj Ballav Sen.¹ At the beginning the higher castes were probably represented strongest in the capital cities though they also figured as petty or local landlords. A series of foreign conquests contributed to disperse them more in the countryside, where they owned land and supervised agricultural work though they did not drive the plough themselves.

Danda bhukti, comprising Bankura (11 p.c.) and Midnapore (5 p.c.) which could not be conquered effectively at all by the Muhammadans also show large proportions. Bankura which in fact shows the highest figure in Bengal, leaving aside Calcutta, never yielded to the Muhammadan arms under the strong protection of the jungle which contributed to keep alive the independence of the Vishnupur Raj till recent times. Indirectly the present distribution of the higher class Hindus suggests their strong aversion for migration although ancient family records furnish many instances of Brahmin families migrating with the vicissitudes of political and social history from Vikrampur to Jessore and thence to Burdwan during a period of three or four centuries.

Man's Disregard of the Natural Balance of a River System. In addition to the concepts of an ecologic balance of land, trees and waters in a given region and a soil balance, established by the intake of the crops and soil replenishment, we have to introduce the concept of a vast and intricate natural balance established among the various tributary streams of a river system.² When man upsets this balance he has to pay the price. Both the silting up of the rivers and the recurrent floods in the Gangetic delta are due to man's artificial interference and disregard of the life and

¹ See Beveridge: *Bakarganj District*, p. 258.

² *Report of the House Committee on Flood Control* (of the Mississippi river).

process of the river system by general deforestation, drainage and development of the vast plains region. The destruction of forests in the catchment areas of the tributaries of the Ganges in Kumaon, Tehri, Garhwal, the Nepal frontier, the Darjeeling and Assam ranges and the Chota Nagpur plateau has caused rapid run-off and erosion, leading to the deposit of soil debris on river beds in low lands thus increasing the damage from floods. Overgrazing by countless flocks of cattle, sheep and goats in the up-river areas has also caused much erosion and rapid run-off. The very expansion of agriculture in the United Provinces and the reclamation of swamps and lowlands, especially in Oudh, in the eastern districts of the United Provinces and in Bihar have also forced an exceedingly heavy run-off. Water which was stored by forests and swamps and was drained slowly now pours out in turbid torrents through millions of man-made gullies into the rivers and fills their beds with mud and overflows their banks. The accepted method of crop production by breaking up the hard soil, careful tillage and preparation of the old alluvium and the production of only cultivated crops facilitate soil erosion and decrease the water-holding capacity of the soil. "Even the direction of a furrow in ploughing may affect the amount of the water that flows on the surface of the field, and the amount of sediment it carries."

Lack of Co-ordination of the Agricultural Interests of Up and Down River Areas. The ravine lands of the United Provinces, covering between half a million and a million acres which have been caused by centuries of intense erosion, are harmful both for up- and low-river areas. Some ravines which are dry and barren become roaring cataracts of liquid mud during the monsoon season. Thus the evil of extension of ravine land is not confined to the United Provinces, where it means the conversion of arable into desert-like and unculturable areas, but extends to the Bengal

delta, where the removal of the soil of whole valleys by denudation has led to the silting-up of river beds. Canalisation in the United Provinces has further aided the silting up processes through the diversion of vast volumes of water. Approximately, 20,000 cusecs are abstracted from the Ganges by the Ganges and Sarda Canals, amounting to 30 or 40 per cent. of the total discharge of the river Ganges. There has resulted probably a general reduction of the summer level of the Ganges by two to three feet, which has thereby increased the difficulty of maintaining the entrances of the feeders and spill channels open to the Ganges. Roads, railways and cities have aided in piling up the flood waters by encroaching upon the natural beds of streams and making their cross sections too small to carry the large bodies of waters.

In fact the extension of cultivation and the expansion of irrigation, which have developed the up-river areas, are largely responsible for the great problems of the Bengal delta. It is true that seepage from the surrounding riverine land in certain measure makes up for the loss of discharge, but this leads to a general lowering of the sub-soil water in the surrounding region to the detriment of agriculture. The seepage cannot compensate fully for the loss of discharge, which leads to a diminution of the cross section of the river, and consequent raising of the river bed by a silting-up process. In the deltaic tracts as well the building of roads, railways or river embankments have prevented free river spill and discharge, while the natural growth of population has sent peasants into the lower areas. Thus man has invaded the river's domain. The flood embankments which by excluding the flood spill are in large measure responsible for agricultural deterioration, water-logging and malaria, now cover more than 1,500 miles in Western and Central Bengal. Many such embankments are necessary no doubt to protect villages and towns, roads and railways against floods.

But the floods now confined within the marginal embankments are raising the river beds, necessitating higher and higher embankments and aggravating the risks of occasional breaches in the unprotected earthen *bundhs* caused by a concentrated discharge. A superintending engineer in Bengal observes : " The irrigation engineers in Bengal are thus faced with the most unenviable situation created by the lowering of land to be drained and rise of river beds into which the drainage has ultimately to be disposed of, and in some areas it has already become impossible to drain by gravity as in Sabong-Moyna circuit in Midnapore District. And a very serious situation is developing by the attempt to confine the floods within the narrow river channels by means of earthen embankments. As a direct consequence of embanking these rivers preventing free spill over the countryside, there was a considerable rise in the flood level soon after these embankments were constructed, and this level is tending to rise higher and higher owing to the gradual rise of the river beds."

The solution will in large measure lie in pulling down the embankments wherever possible and introducing the spill water annually throughout the countryside, that must result in gradual land-building and improvement of fertility. With the removal of the embankments, the flood level will also fall and will be lower and lower as the land rises higher by the deposition of silt. The villagers should also be educated to build their huts on earthen mounds and avoid mud-walls as in eastern Bengal. New village sites should be located as far as possible on ridges and uplands so that flooding while being beneficial to the land and the crops may not endanger property and the livestock. It is true that the present distribution of rural settlements, roads and railways, greatly limits the scope of flood-flushing, but controlled flood-flushing by means of regulated escapes and the provision of drainage channels can certainly be intro-

duced into wide areas. Moreover, there is a limit as regards the depth of water which can safely be withheld by unprotected earthen embankments and that limit has already been reached for some rivers, as, for instance, the Damodar.¹ As years pass and the flood level ever rises higher, the potential danger to the countryside from floods increases. The old policy of maintaining high embankments demands revision, therefore, for more than one reason. Man's premature settlement of swamps and low-lands has now brought on his head Nature's revenge in more than one way, and he can only live safely and thrive by permitting Nature to renew the process of land-building and land-raising, which he has prematurely cut short.

On the one hand, an increase of erosion and drainage in the up-river areas contribute towards a heavy and rapid run-off in the monsoon season. On the other hand, the network of canals has reduced both the discharge as well as the velocity of the river and led to a permanent reduction of its level, thereby making it impossible for many feeders and tributaries to remain open channels throughout the year and facilitating the process of silting-up. Both the silting-up of many tributaries and spill channels of the Ganges, and the encroachment of population into low and alluvial lands of the lower delta have reduced the areas left for natural storage basins in Bengal. The Nadia rivers are to-day no more than channels of local drainage and are quite unfitted for this service having been formed to carry much larger volume of water. Thus many of them maintain but a languid vitality during the monsoon season, and for the greater part of the year are merely chains of stagnant pools choked with vegetation. On the other hand, the Padma, and the Jamuna into which all available flow

¹ Mazumdar : Irrigation Problems in Bengal, *Science and Culture*, October, 1935.

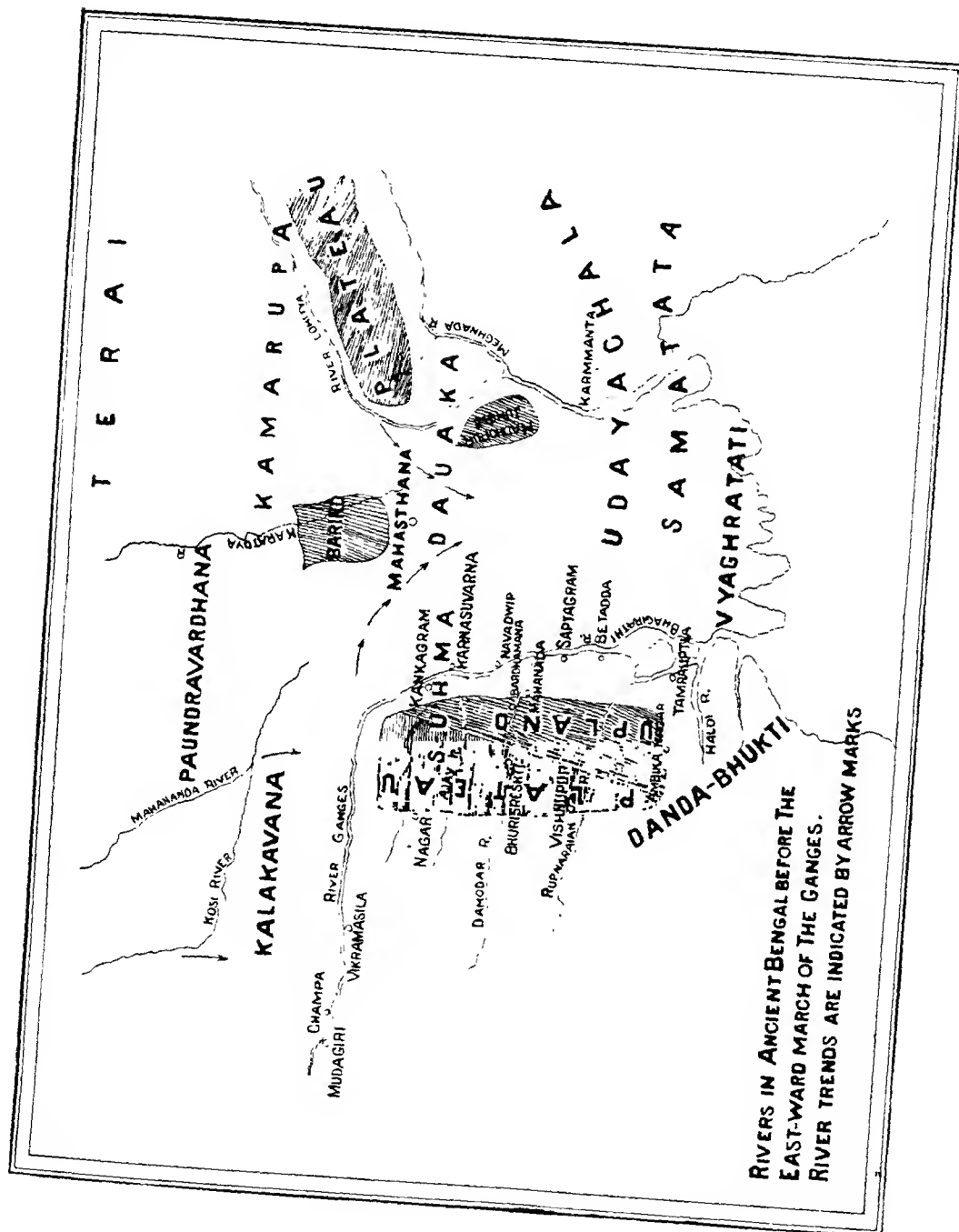
is concentrated erode their banks rapidly, and are subject to recurrent floods whose effects become more and more destructive as population continues to increase in the riverine areas. The restoration of the spill channels of the Ganges in Central and Western Bengal so as to carry their appropriate quota of flood discharge will, it is expected, lessen the dangers from erosion and flooding in Eastern Bengal. What we should firmly grip in mind is the balance of the river and drainage system as a whole comprising the catchment areas in the upper plains, the flanks of the rivers in the middle plains and the low lands in the delta. No doubt the silting up of the rivers and the recurrent floods in Bengal are due in large measure to the remarkable expansion of the cultivated area, the marvellous schemes of canalisation in the United Provinces, the scouring of deep and rich soils by uncontrolled drainage and deforestation and reclamation in Northern Bihar, Assam and Chota Nagpur.

The Gangetic Problems, not Provincial but Federal. Deforestation, soil erosion, reclamation of swamps and irrigation thus have given rise to problems of more than provincial significance in the Ganges Valley. Such problems can only be tackled by the Indian Federal Government, which should maintain the integrity of the entire river system as a unified whole.

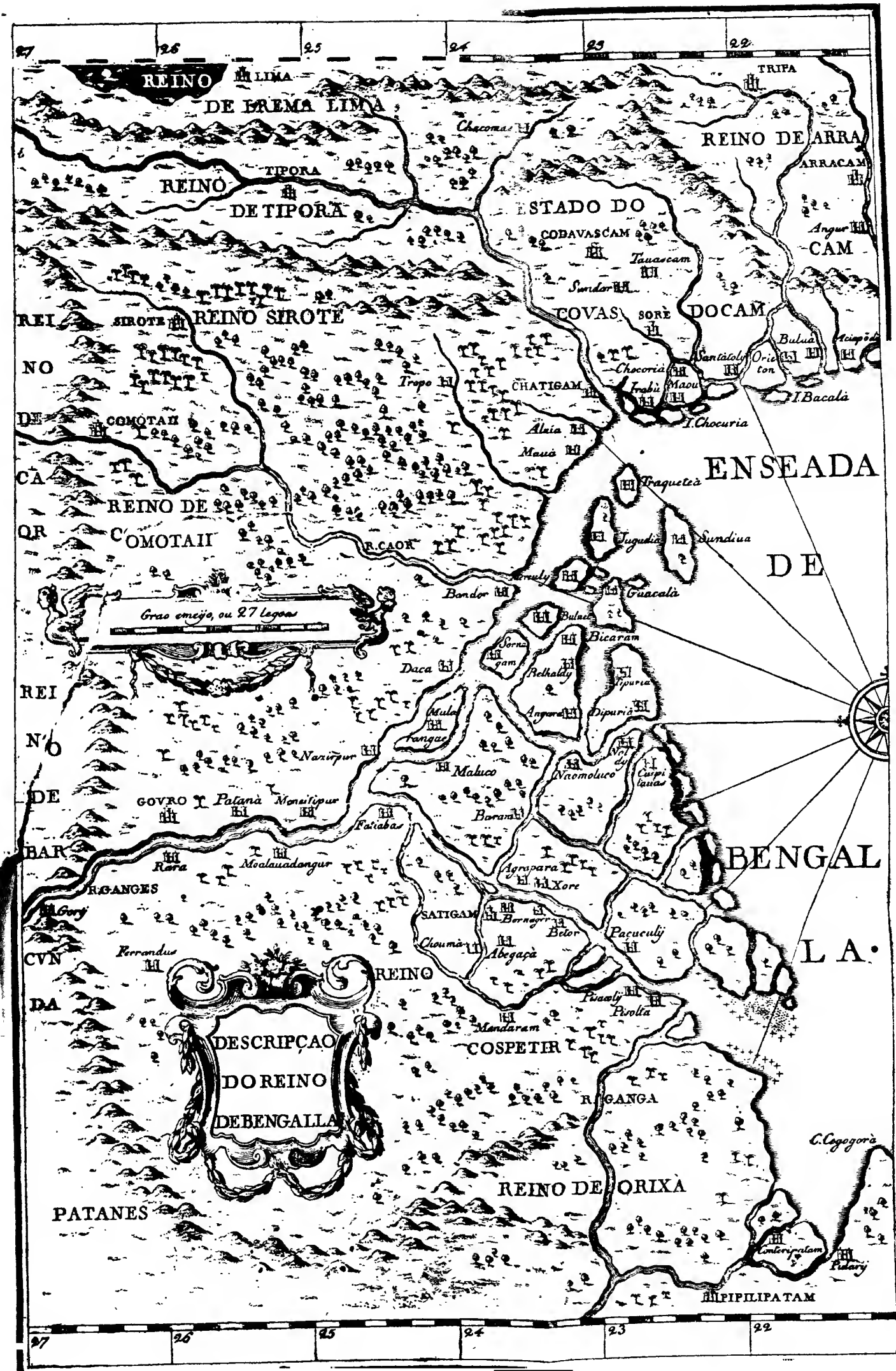
The need of a Ganges River Commission. The Joint Select Committee of the Parliament on the Indian Reforms have recognised the dangers of treating irrigation and water problems as provincial subjects, but their recommendations do not go far enough. The task left to the Governor-General in Council is one of adjudication rather than of initiation of policies. Moreover, the problems to be dealt with are not merely those of the allocation of provincial revenues for expenditure on public works executed on an inter-provincial scale. These embrace such varied and wide economic issues as inland navigation

and colonisation, transport and public health as well as the shrinkage and expansion of arable land and its yield in contrasted zones of rural settlement. These tasks can only be entrusted to an Indian Waterways and Irrigation Board or a Ganges River Commission, constituted by the Federal Government on the lines of the Mississippi River Commission in the United States, which will adopt a comprehensive policy of federal management of an adequate and effective nature. Such a permanent expert board should arbitrate between the conflicting claims of canal irrigation in the up-river areas and navigation and lagoon irrigation in the down-river areas, and initiate and co-ordinate measures of river control through reforestation, improved soil management to prevent erosion, control at the sources of the tributaries and by reservoirs along the streams and the construction of levees, diversion, and safety valve and spill ways and other engineering works in the down-river areas. The construction of dams and weirs in the upper reaches of the rivers that bring violent floods and the restoration of the dead or dying rivers by introducing unto them their surplus waters which bring havoc or run to waste are also indispensable, and, indeed, for Bengal we find such early schemes of canalisation as those of the Superintendent of the Nadia Rivers in 1836, who proposed a still water canal from the Hooghly river near Santipur to Mangra on the Navaganga, or of the Military Boards in 1844, which reported that no permanent improvements could be made in the channels of the Nadia rivers and recommended a canal from Kalna on the Bhagirathi to Rajmahal on the Ganges. These schemes are precursors of the many similar and other schemes of present-day irrigation engineers. The control of the Ganges and the Brahmaputra and of their tributaries is a vast and intricate undertaking which requires the co-ordination of divergent interests of different provinces and regions. No province must be permitted any longer to pursue its own

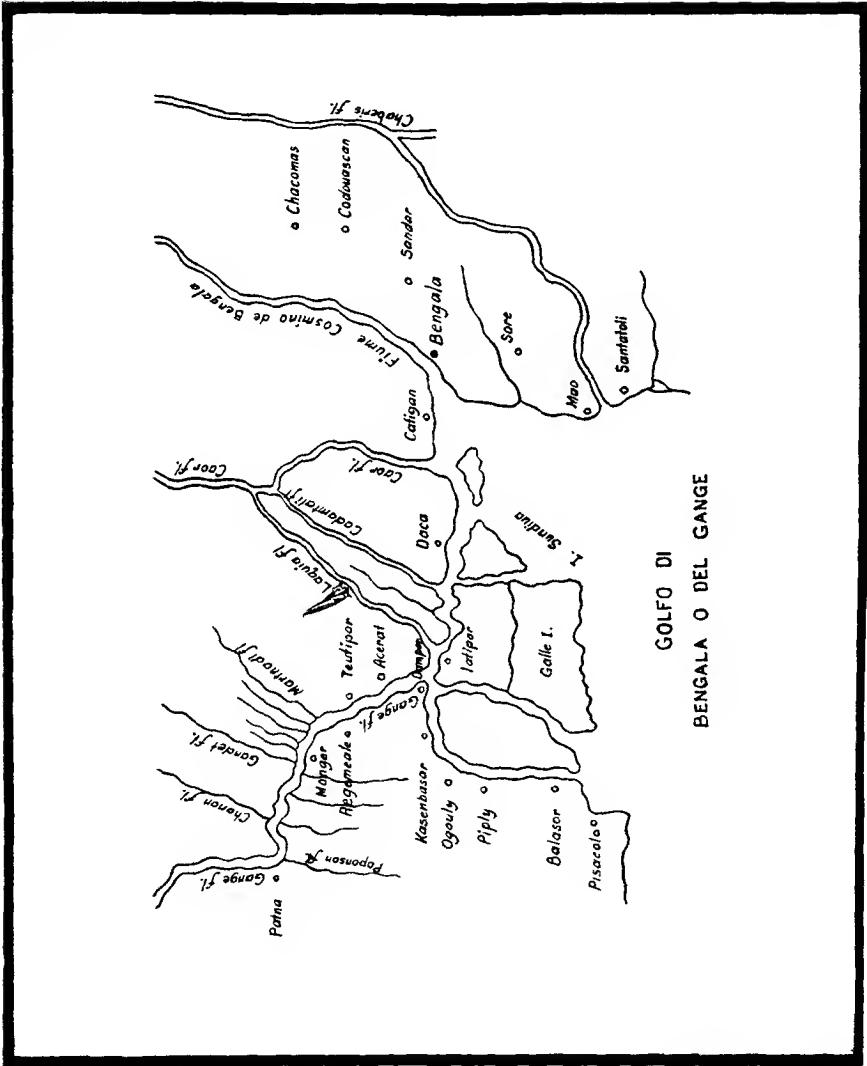
regional policy as regards waters, and forests, which affect the fortunes of so many millions outside its boundaries. A co-ordinated policy of forest, soil and water management, based on the recognition of the river and drainage system as an integral whole, must now be deemed essential in order that the prosperity of this vast valley which has increased in population from about 50 millions to 125 millions in four centuries may be more evenly distributed in the future and be not jeopardised by recurrent famine, flood and malaria. In the coming decades the increase of population will aggravate the economic unbalance of land and trees and water, bringing agriculture and with it man to a common doom with the region, a fact so strikingly foreshadowed by the extension of water-less wastes in the flanks of the Jamuna and of water-logged wastes in large parts of North Bihar and about two-fifths of Bengal. The postponement of a co-ordinated programme would not only imply greater recurrent national losses, due to denudation, flood and spread of sands and jungle, but may also range the provinces and regions in conflicting camps to make a comprehensive and integrated stream control impossible in the future.



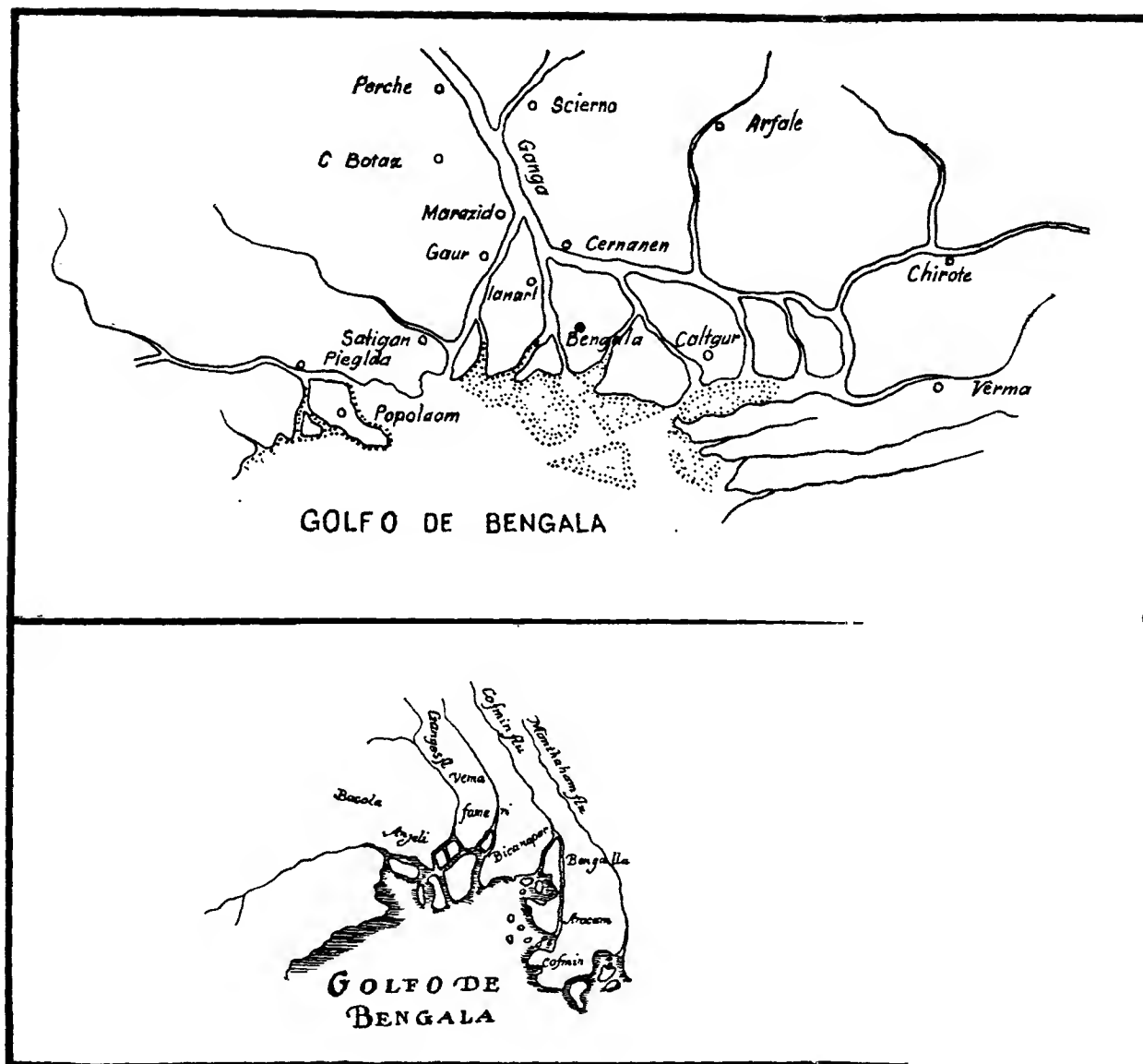




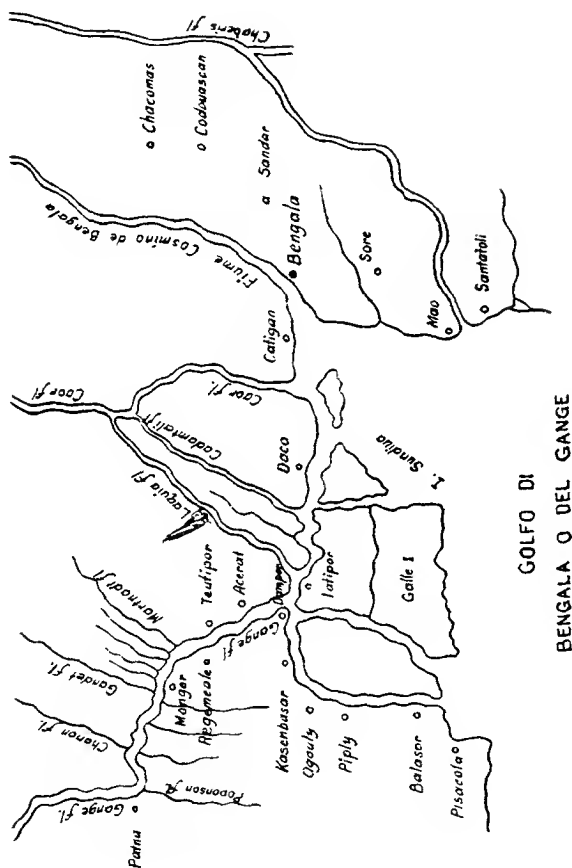
Jao de Barros' Map of Bengal.



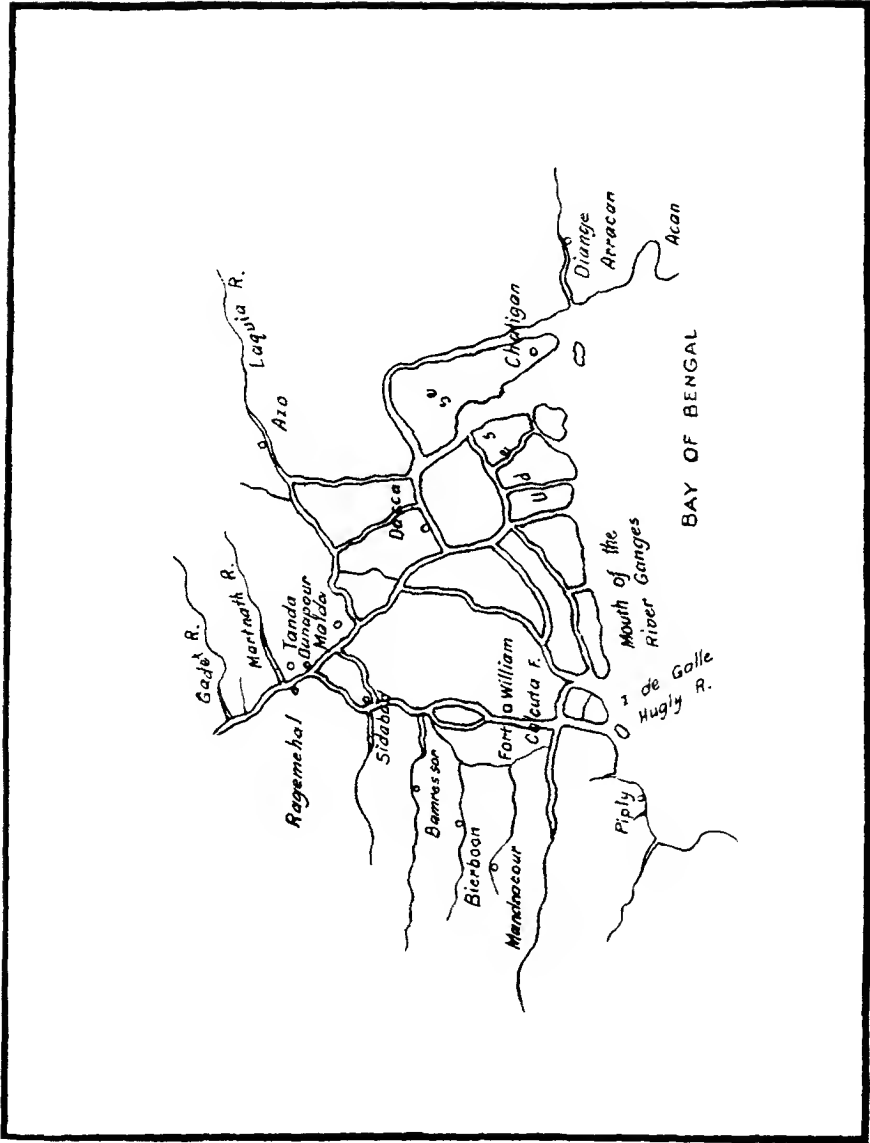
Bengal from Cantelli Da Vignolla's Map of India (1683).



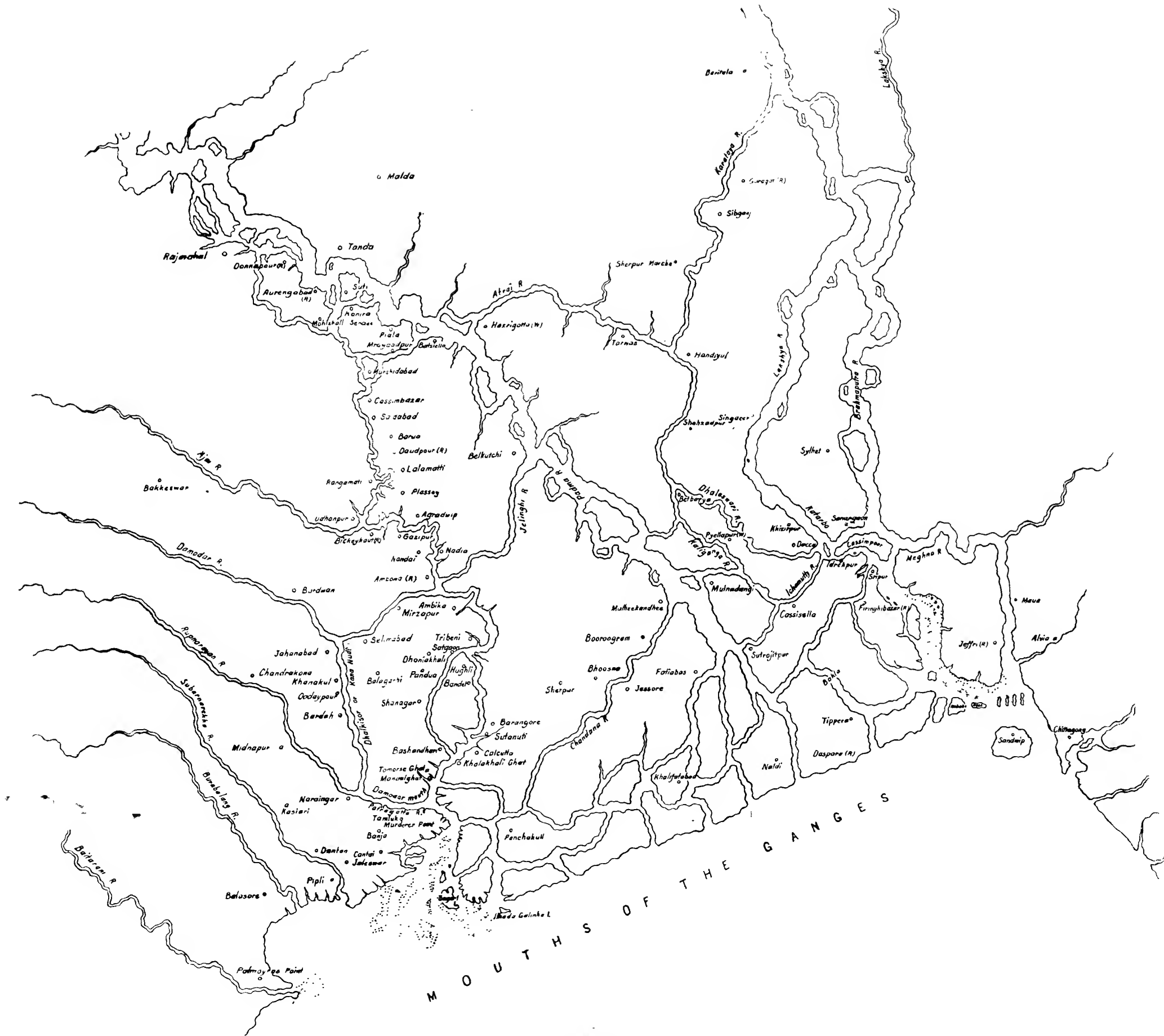
Above—Bengal from Gastaldi's Map of Asia (1561).
Below—Bengal from Hondius' Map of the East Indies (1614).



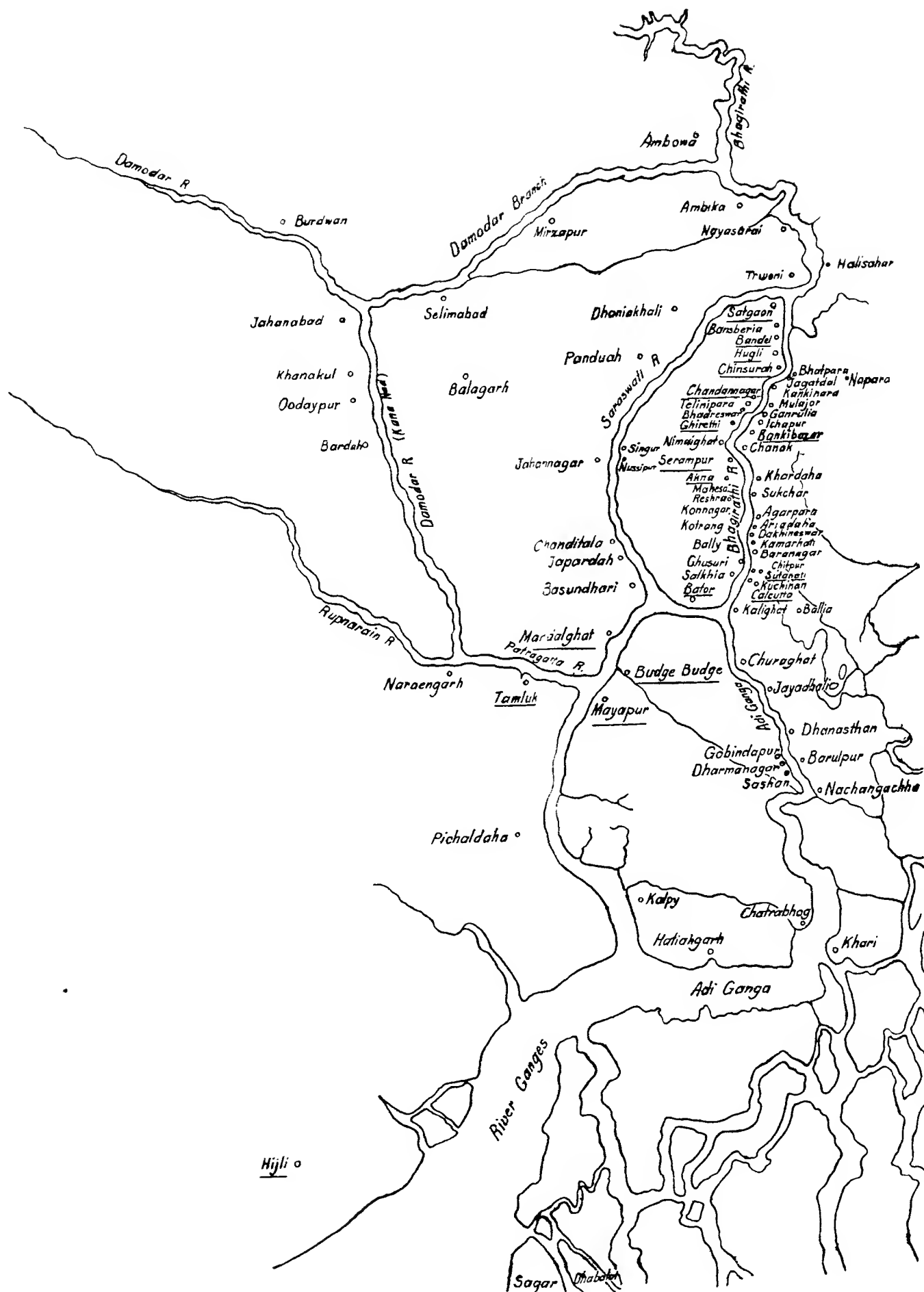
Bengal from Cantelli Da Vignolla's Map of India (1683).



Bengal from Herman Moll's Map of the East-Indies (1710).

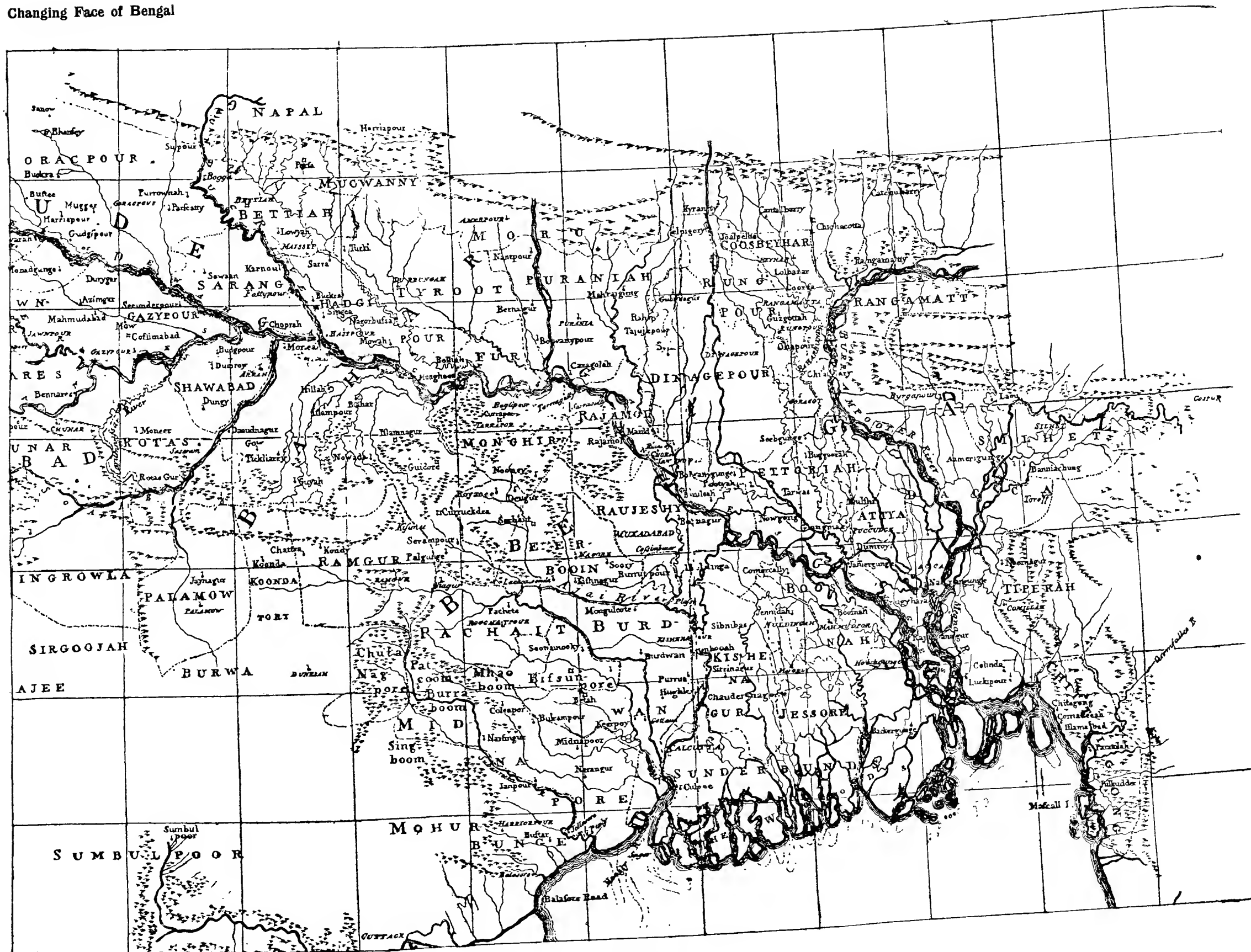


Van den Broucke's Map of Bengal (1660).



The Rivers of Western Bengal in the 16th and 17th Centuries.

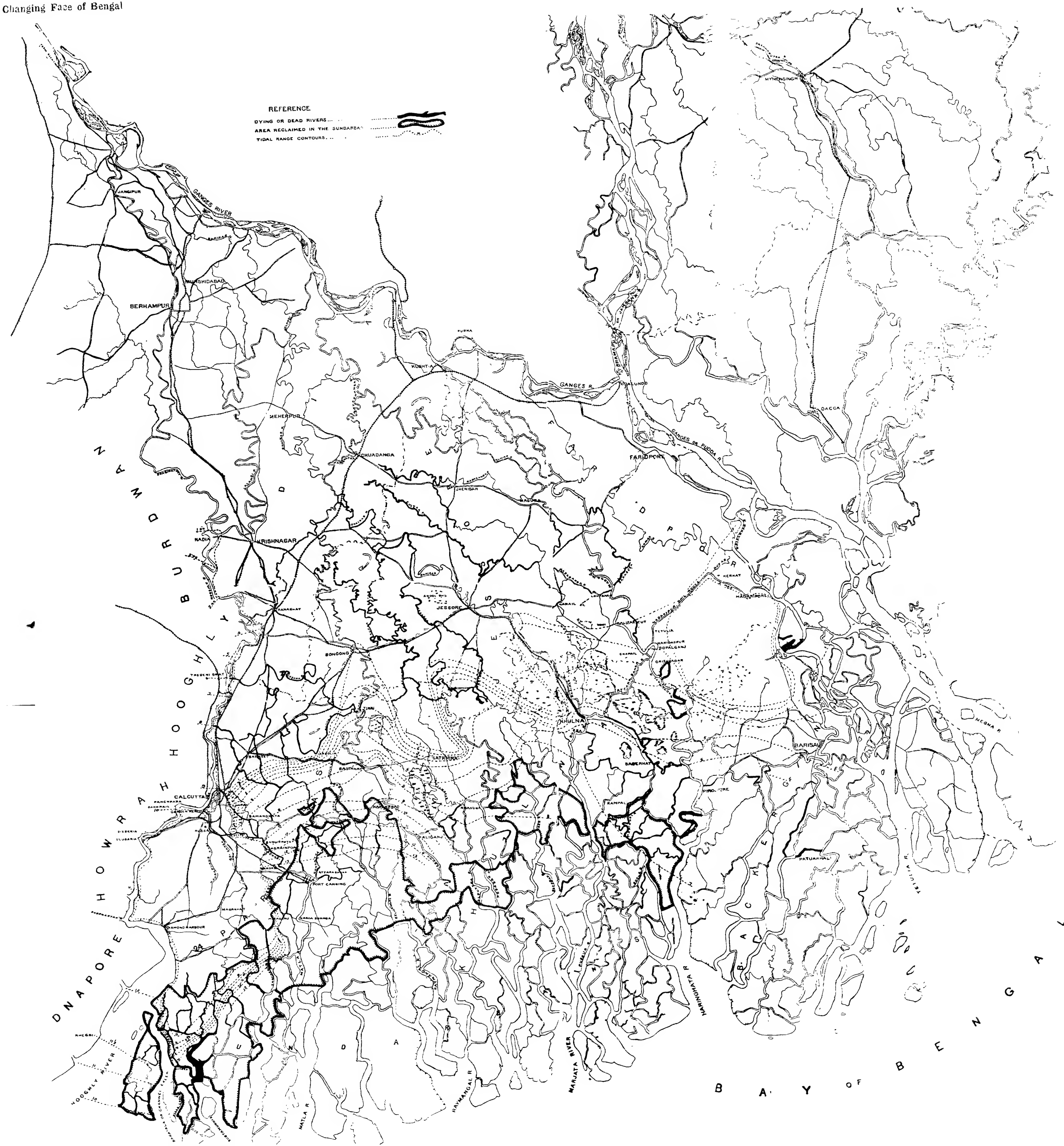
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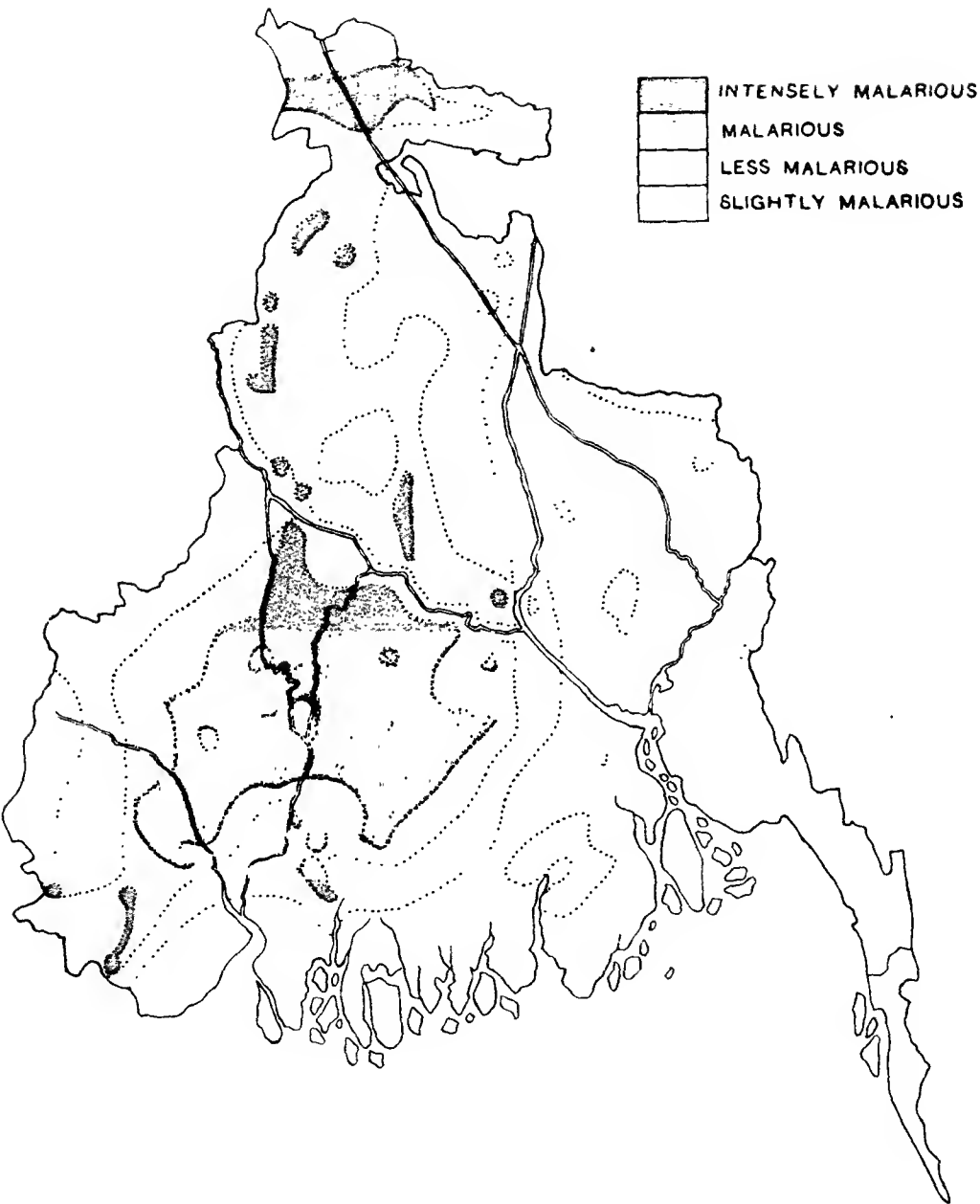


Rennell's map of the Bengal Rivers (1764-1776).

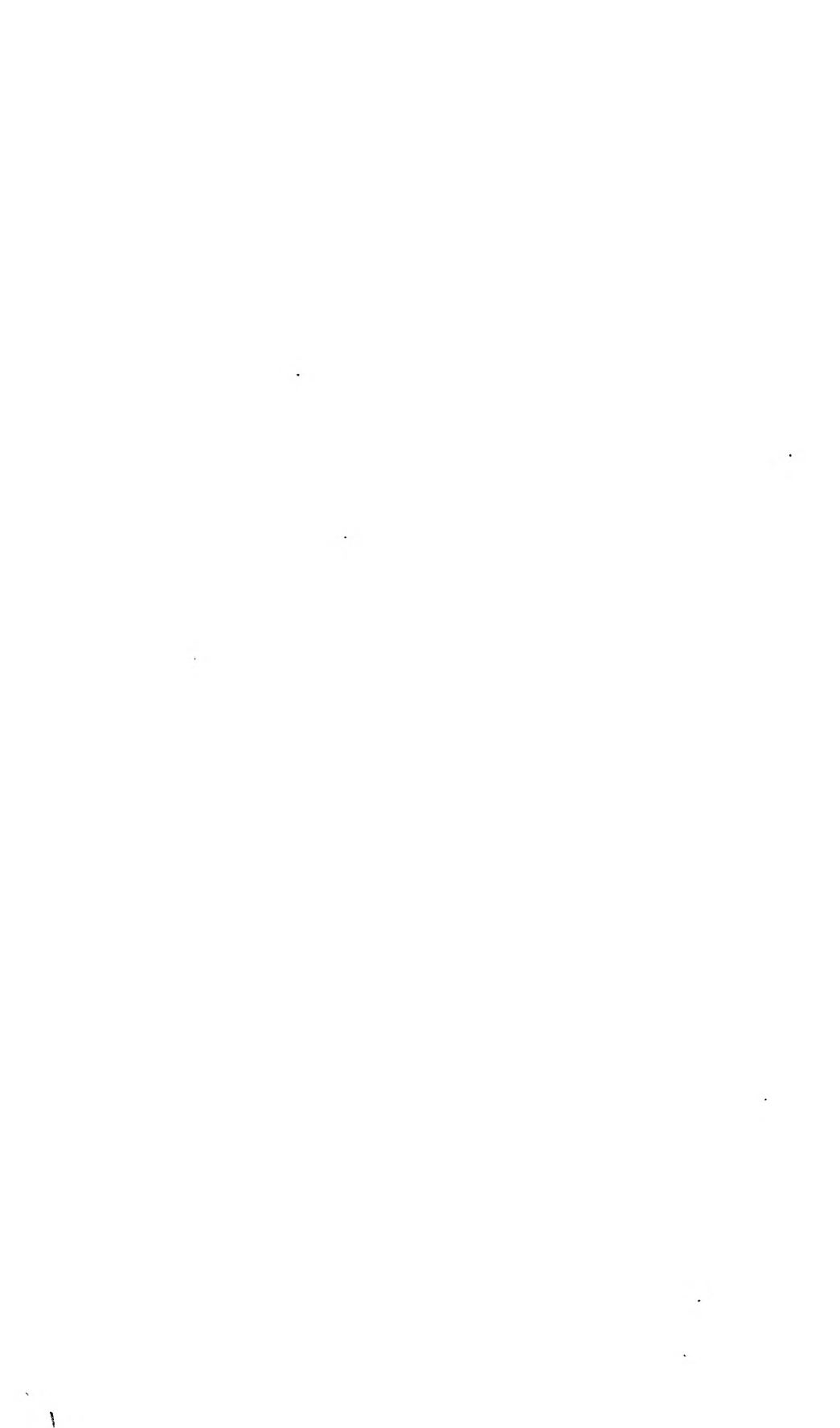


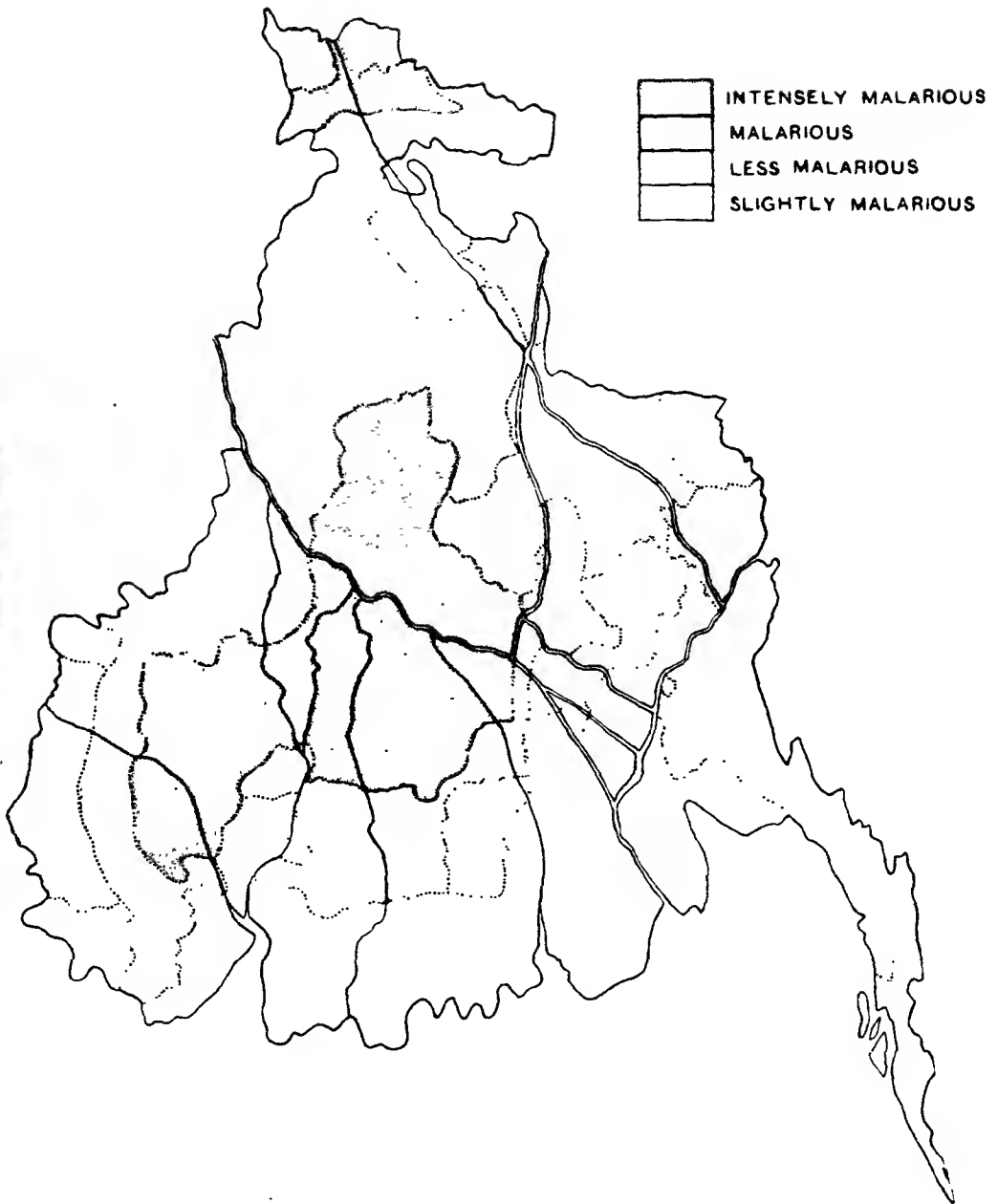
Map of the Dacca District showing the effect of rivers upon Rural Density



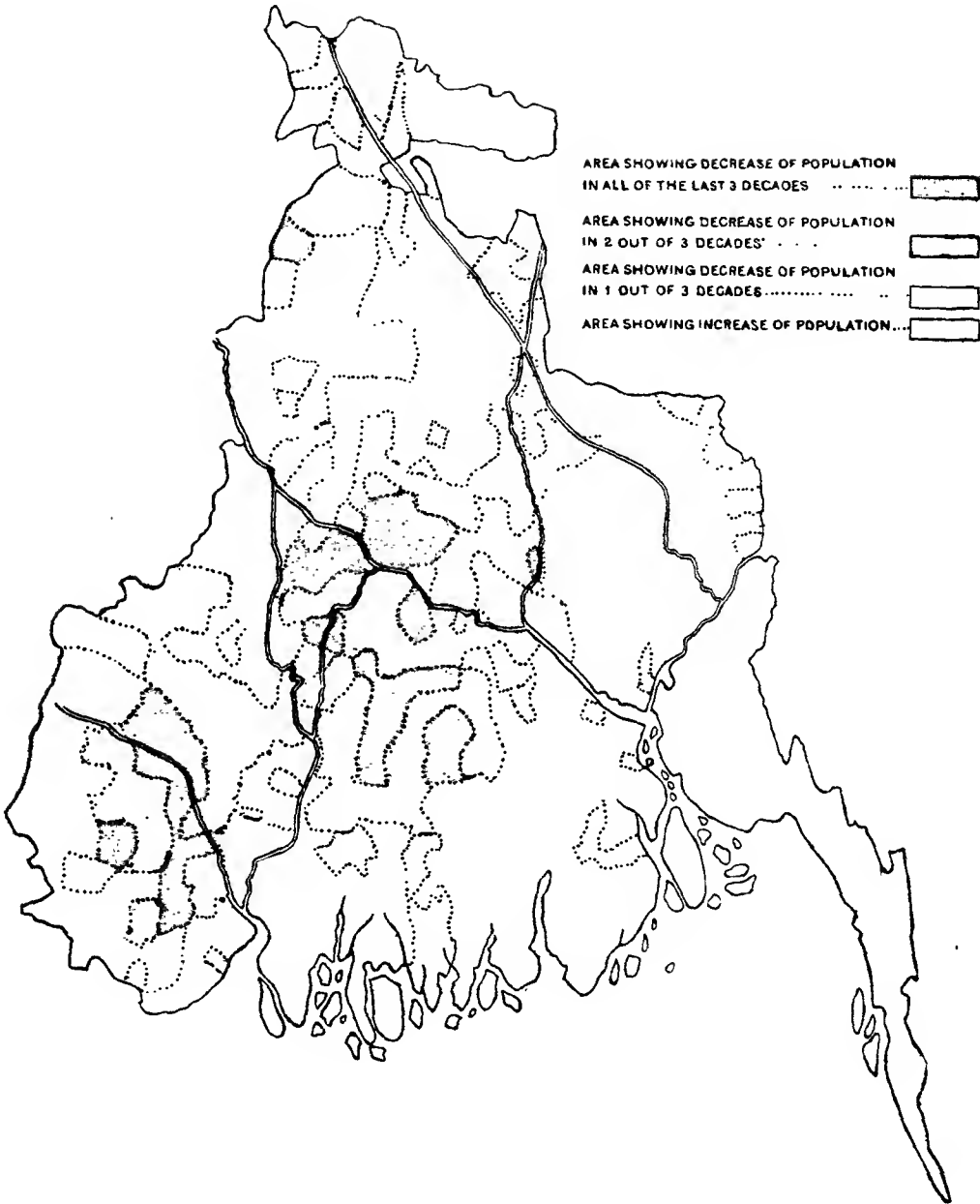


Map showing distribution of Malaria in Bengal in 1916.

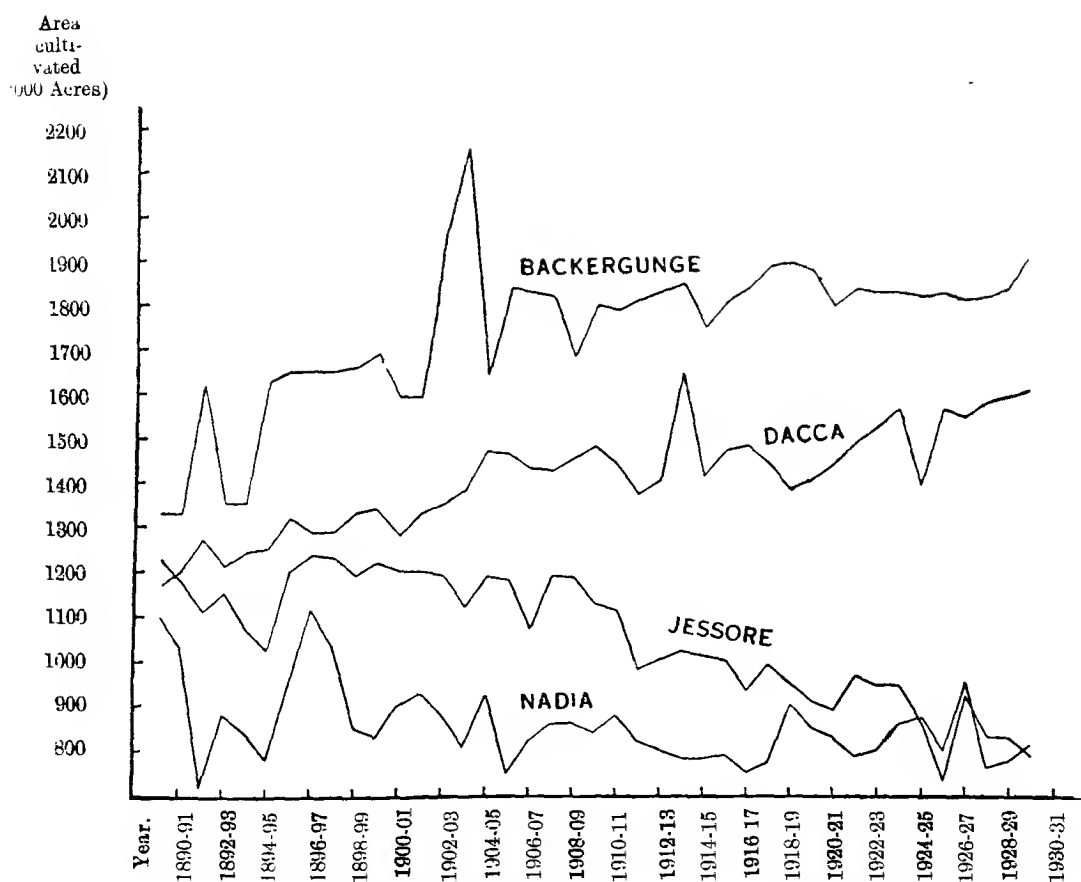




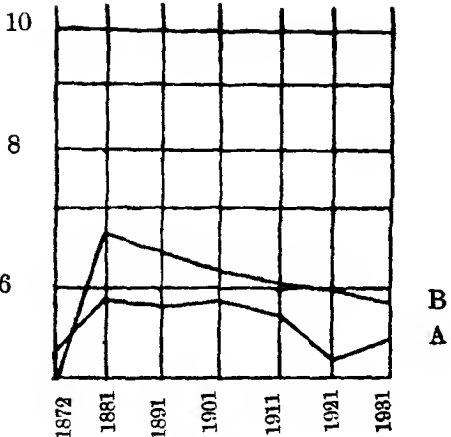
Map showing distribution of Malaria in Bengal in 1934.



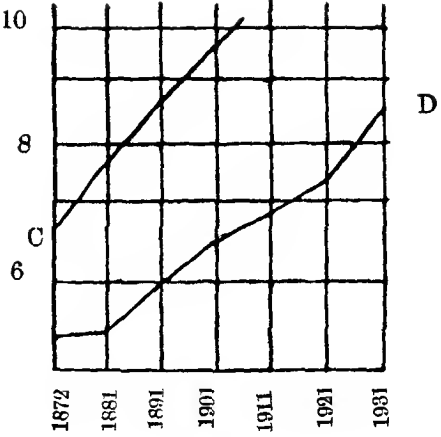
Map showing population variations in the Moribund and the active deltas during the last three decades.



Map showing agricultural contrasts in the moribund and active deltas

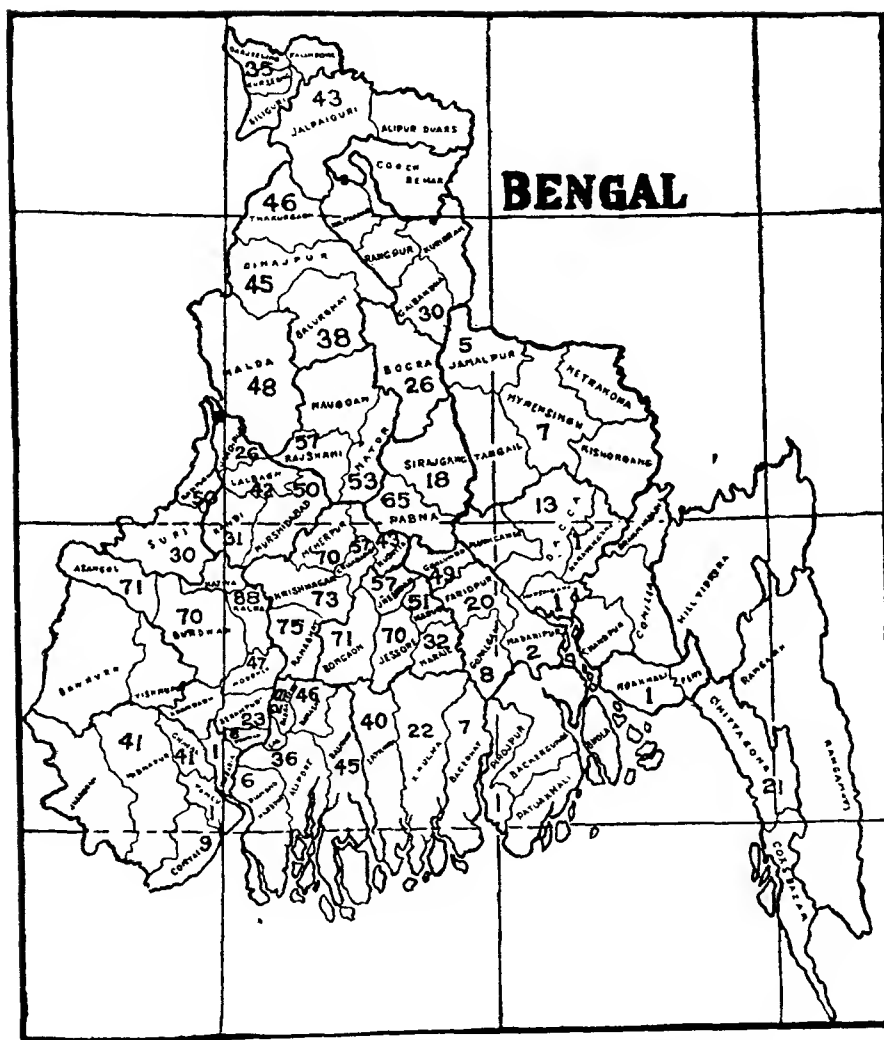


A—Nadia.
B—Jessore.



C—Dacca.
D—Bakargunj.

Map showing contrasts of population variation in the moribund and the active deltas.



Map showing distribution of spleen indices in different districts in Bengal.



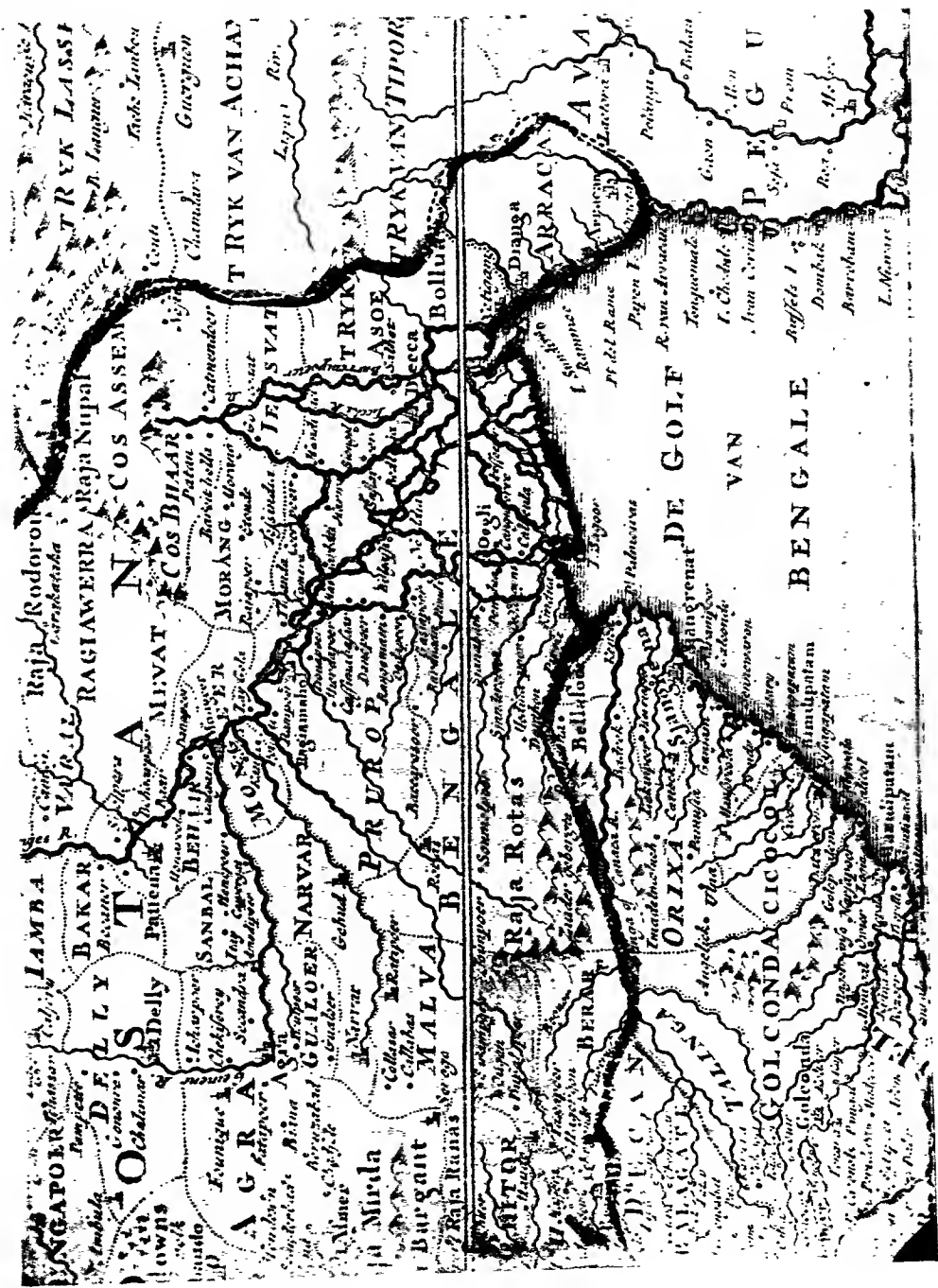
Muller 10018

Sinus Gangeticus vulgo Golfo de Bengala nova descriptio Amstelaedami. Types G. Valli et p. Schenk.

This map is not dated but is certainly older than the second edition described in the Hubner catalogue from 1726. The print proves this. It can safely be dated before 1726.

Courtesy : Geografisch Seminarium, University of Amsterdam.

Dutch Map of the Gulf of Bengal (Beginning of the 18th Century).



Muller 10021
Nieuwe Kaart van het Keizerrijk van de Groot Mogol Uitgegeven te Amsterdam door Izaak Tirion.
Signed : J. Keyser fecit 1730.
Courtesy : Geografisch Seminarium, University of Amsterdam
Bengal from Izaak Tirion's Map of the Moghal Empire (1730)

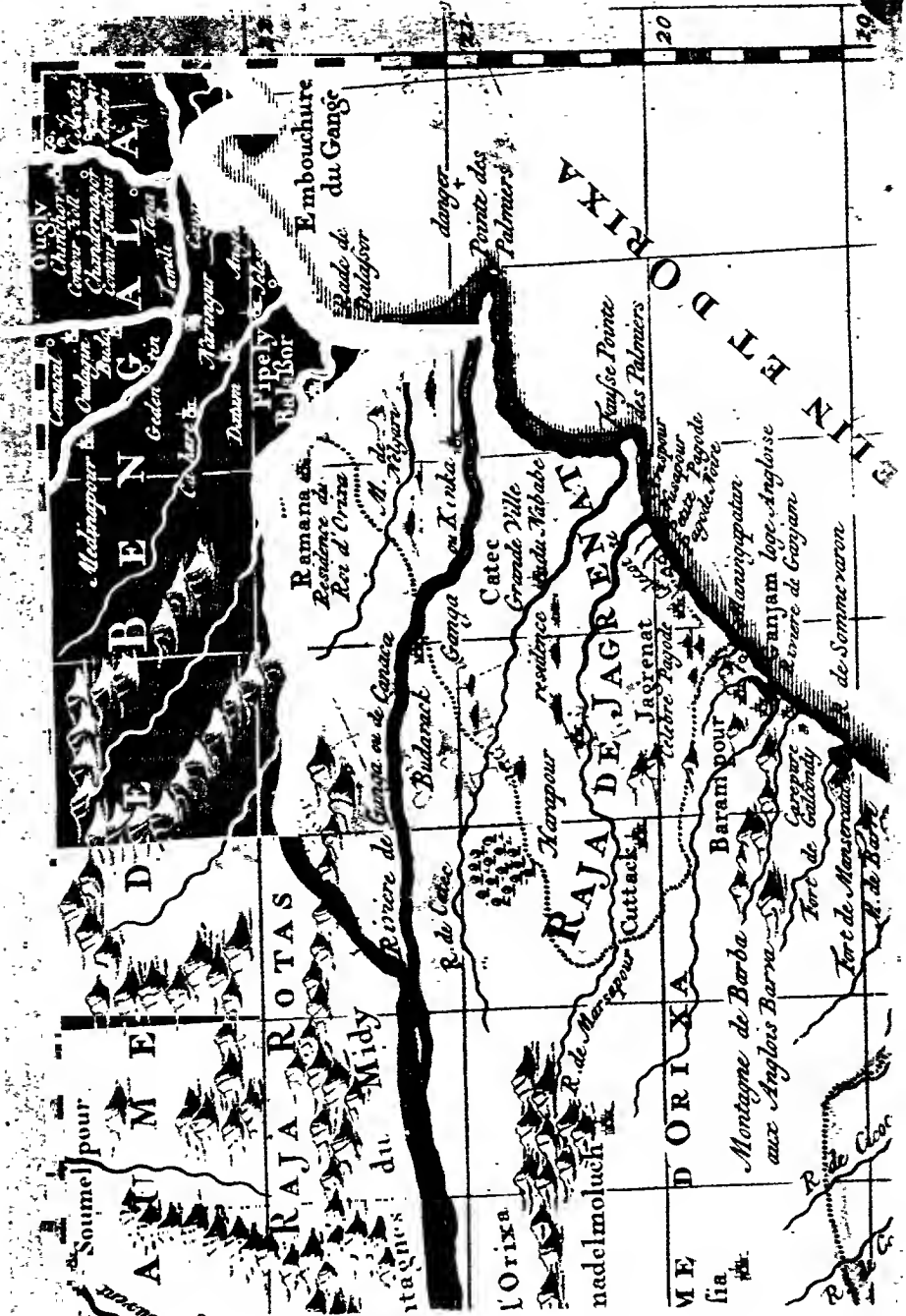


Nieuwe kaart van India over de Ganges, of van Malakka, Cambodja, Champa, Ko-louchina, Laos, Pegu, Ava, enz.

Uitgeeven te Amsterdam door Izaak Tiron

This map is neither signed nor dated. But it is of the same print, size, paper, as 10421 made in 1730 by J. Keyser. Courtesy: Geografisch Seminarium, University of Amsterdam.

Bengal from Izaak Trion's Map of the East Indies (1730).



Muller 10084
Carte des Ganges de Malabar et de Comondol Présentée au Roy par son tres humble
obéissant et tres fidèle Sujet G. Delisle. Amsterdam chez Pierre Schenk l'entré
du Warmoesstraat. The map is not dated. It was most probably printed later than 1720
but before 1740.
Courtesy : Geografisch Seminarium, University of Amsterdam.
Bengal from G. Delisle's Map (1720-1740).



Miller

Magni Mogolis Imperium de novo Correctum et Divisum per F. de. Witt.

Amstelodami ex officia J. Covens, & C. Horties.

The Hubner catalogue dates this map as before 1726.

(Courtesy: Geografisch Seminarium, University of Amsterdam.

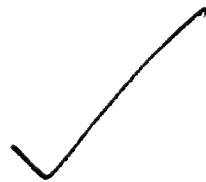
Bengal from T. de Witt's Map (1726)



Carte de l'Inde dressée pour le *Sir*. de l'Auville Secrétaire de S. A. S. le duc d'Orléans, Novembre 1752.

Courtesy : Geografisch Genarium, University of Amsterdam

Bengal from de l'Auville's Map (1752).



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